SOIL SURVEY

Noble County
Oklahoma

Series 1941, No. 16

Issued September 1958

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with the
OKLAHOMA AGRICULTURAL EXPERIMENT STATION

How to Use THE SOIL SURVEY REPORT

THIS REPORT is about the soils of Noble County, Oklahoma. It describes each kind of soil and states how it can be used, how it responds to treatment, how you ought to take care of it, and what yields you can expect. Maps in the jacket show the location and extent of each soil. If you want to know how the soils were formed and how they are classified, some information on these subjects will be found in the technical section (pp. 54 to 60).

SOILS OF A FARM

If you want to know about the soils on a farm or other tract, first find the right place on the map. The map shows township and section lines, towns and villages, roads, streams, most houses in rural areas, and other landmarks. Remember that an inch on the map is 2,000 feet on the ground and that 2.64 inches equal 1 mile. Each soil is shown by a symbol, such as Tb, and the extent of each area is shown by a boundary line. Color patterns also help you pick out the areas of different soils, although each color pattern is used on several soils that resemble each other in some ways.

For general information about management of the soils refer to the section, Management of Noble County Soils. This section discusses the effect of past management and suggests how management can be improved.

The map legend shows the soil symbols, arranged in order so you can find them easily, and the name of each soil. The symbol Tb, for example, is used for Tabler silt loam, 0 to 1 percent slopes. All areas of this soil, wherever they appear on the map, are shown by this symbol and the same color pattern. Soil names are listed in the table of contents, so you can turn easily to the right page in the section, Descriptions of the Soils. This section describes each soil briefly and gives some statements about its use and management.

Yields that you can expect from common crops are shown in table 4. Soils are listed in alphabetic order in the left-hand column of this table. Opposite each soil name you will find the yields of crops that can be expected in average years, under two levels of management. These estimates of yields give you a basis for comparing probable responses of different soils.

SOILS OF THE COUNTY AS A WHOLE

Table 2 in the section, General Nature of the Soils, gives the important characteristics of the soil series in the county. While studying this table, refer to the soil map. The patterns shown on this map frequently indicate well-defined differences in type of farming, land use, and land use problems.

A newcomer to the county, especially if he considers buying land, will want to know about the climate; types of farms; principal farm products and how they are marketed; kinds and conditions of farm tenure; availability of water, roads, railroads, and markets; and locations of towns and population centers. Information about all these will be found in the sections, General Nature of the County, and Additional Facts about Noble County.

This publication on the soil survey of Noble County, Oklahoma, is a cooperative contribution from the—

SOIL CONSERVATION SERVICE

and the

OKLAHOMA AGRICULTURAL EXPERIMENT STATION

Series 1941, No. 16 Issued September 1956

SOIL SURVEY OF NOBLE COUNTY, OKLAHOMA

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United States Department of Agriculture in cooperation with the Oklahoma Experiment Station

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[1] Field work for this survey was done under the direction of Soil Survey while it was part of the Bureau of Plant Industry, Soils, and Agricultural Engineering. Soil Survey was transferred to the Soil Conservation Service on November 15, 1952.

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NOBLE COUNTY is an undulating to rolling prairie area in north-central Oklahoma. The dominant soils have developed under grass. For the most part, their surface layers are slightly to moderately acid loams and silt loams, and their subsoils are limy, compact, very slowly permeable clays. The soils and climate favor production of winter wheat and beef cattle, the main sources of farm income. The soils are still fairly productive, but continuous cropping for the past 50 years has lowered yields and allowed erosion. Large acreages once cropped are now used for pasture or have been abandoned. More cropland will be lost unless soil managment is improved. This soil survey is designed to aid farmers in planning management that will check decline in yields and control erosion. It is a cooperative contribution from the United States Department of Agriculture and the Oklahoma Agricultural Experiment Station. Field work for the survey was completed in 1941, and, unless otherwise specifically indicated, all statements in this report refer to conditions in the county at that time.

GENERAL NATURE OF THE COUNTY

LOCATION AND EXTENT

Noble County is located in north-central Oklahoma (fig. 1). It is separated from Kansas by Kay County, Okla. Perry, the county seat, is about 55 miles northeast of Oklahoma City, 75 miles west of Tulsa, and 35 miles southeast of Enid. The county is roughly rectangular and has an area of 747 square miles, or 478,080 acres. The county is at the eastern end of the main wheat-producing section of the State, and on the southern edge of the tall-grass prairies of the central United States.

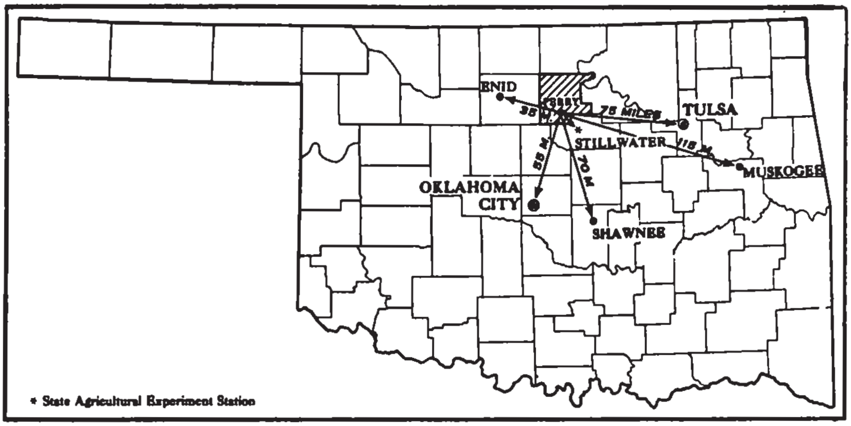


FIGURE 1.—Location of Noble County in Oklahoma.

CLIMATE

Noble County has a continental, warm-temperate, subhumid climate. Summers are decidedly warm and winters are fairly mild and open. The climate is healthful, as it is neither excessively wet nor dry. Cooling breezes moderate the high summer temperatures. Bright sunshine makes the winter temperatures seem less severe. Breezes or winds, blowing almost constantly through the year, are objectionable to people from the Southern and Eastern States, but welcome to all in midsummer. Table 1, compiled from records at the weather station in Perry, shows normal monthly, seasonal, and annual temperatures and precipitation.

The average annual precipitation is 34.24 inches. The month of greatest rainfall are those in which crops are growing, April through September. Figures for a long period indicate a fairly even distribution of rainfall during the growing season. Nevertheless, dry spells lasting 4 to 6 weeks are fairly common. These dry spells do not cause crop failure but they curtail yields. Corn, which matures during the hot part of the summer, is most frequently damaged.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Perry, Noble County, Okla.*

[Elevation, 871 feet]

Month	Temperature [1]			Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average	Total for the driest year	Total for the wettest year	Average snowfall
	°F.	*°F.*	*°F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	39.2	79	−8	1.54	1.13	(3)	1.9
January	37.3	80	−20	1.02	.18	1.34	2.6
February	41.1	91	−20	1.31	.36	5.38	3.0
Winter	39.2	91	−20	3.87	1.67	6.72	7.5
March	49.4	100	5	1.78	0	3.10	.7
April	60.0	95	21	3.84	.60	5.11	(3)
May	68.1	102	27	5.14	4.18	9.81	0
Spring	59.1	102	5	10.76	4.78	18.02	.7
June	77.0	109	44	4.12	2.37	9.70	0
July	82.4	111	50	2.51	.13	2.03	0
August	82.0	113	45	3.59	.41	3.47	0
Summer	80.4	113	44	10.22	2.91	15.20	0
September	74.2	107	32	4.10	5.44	7.14	0
October	62.9	100	15	3.15	2.94	10.26	(3)
November	49.9	86	9	2.14	.60	6.00	.3
Fall	62.3	107	9	9.39	8.98	23.40	.3
Year	60.3	113	−20	34.24	[4] 18.34	[5] 63.34	8.5

[1] Average temperature based on 56-year record, 1897–1953; highest and lowest temperatures on a 33-year record, 1897–1930.

[2] Average precipitation based on 46 years of record from 1899 to 1953; wettest and driest years based on 46 years of record, 1899–1953; snowfall based on a 33-year record, 1897–1930.

[3] Trace.

[4] In 1936.

[5] In 1908.

The soils are driest late in July and in August. High temperatures, high transpiration of moisture by plants, and drying winds remove moisture rapidly. The dry spells are most damaging on the extensive soils that have a subsoil of heavy clay. Part of the crop damage results from shrinking of the clay on drying. The cracks speed the rate of soil drying and also rupture plant roots. Drought damage is less on the more friable soils that have a sandy clay or sandy loam subsoil. The soils on the stream terraces and bottom lands show less damage from drought than those on the uplands, because they lose less water as runoff and many of them receive additional water from the upland.

Late spring, summer, and early fall rains often come as hard showers. Winter rains are fairly gentle and steady. Wet spells are rare but occasionally delay harvest, or may prevent harvesting of small grains on the soils that have slow drainage. The wet spells also favor the spread and development of leaf and stem rusts of wheat, which sometimes greatly reduce yields. Severe hailstorms occur somewhere in the county nearly every year. The chance of a crop being hailed out is about one in ten.

The climate tends to hinder severe infestations of insects. Hot summers and low winter temperatures help control the boll weevil, the principal enemy of cotton. Dry periods during the growing period tend to check the hessian fly, a serious pest of wheat. Hard showers in May help control the chinch bug, which is probably the pest that most frequently damages crops. The chinch bug spends the winter on small grains and crawls to corn and sorghums in summer. Hard showers drown the insect in the crawling stage. Hard showers also drown the greenbug, which sometimes seriously damages small grains. Wet weather in summer favors the chinch bug. The armyworm is more numerous when a wet season follows one or two dry seasons.

The frost-free growing season is 206 days, or from April 8 to October 31. Late frosts often destroy or seriously injure fruit crops. Early and late frost are more likely in valleys, where air drainage is deficient. Fruit trees on north slopes are less injured by frost because they bloom later. The latest frost recorded came on May 10, and the earliest in fall on September 26. The growing season is long enough to mature cotton, but little of that crop is grown. Winter wheat is far the most important crop, because it matures before the hot, dry weather of midsummer. Moreover, much of the county consists of soils with a heavy clay subsoil that are better suited to wheat than row crops.

The prevailing winds are from the south. The average 3 o'clock wind velocity for the year is 14 miles per hour. Tornadoes pass through the county but rarely cause much damage unless they pass through a thickly populated area. Shifts in the wind during winter cause wide variations in temperature. "Northers" lasting 3 or 4 days come in winter. They bring rapid drops in temperature, which are moderated when the southerly winds return. Farm work can be done every month of the year, though little is done during the northers and the hot spells in summer.

The average relative humidity at 2:00 p. m. is 60 percent in January, 40 percent in April, 48 percent in July, and 50 percent in October. The sun shines 59 percent of the possible time in winter, 62 percent in spring, 75 percent in summer, and 70 percent in fall.

In summary, the climate of Noble County favors a stable type of agriculture largely based on the production of winter wheat, oats, corn, and livestock. Yields fluctuate widely because of intermittent dry spells. The farmer needs to keep surplus money or products on hand to tide him over the dry years. The rainfall is not great, and, as a result, the soils are not strongly leached and do not need heavy applications of fertilizer for crop production.

WATER SUPPLIES

An adequate supply of drinking water is available 30 to 100 feet under most of the uplands. In many places it occurs at lesser depths in the bottom lands. Windmills use the almost constant breeze to pump well water. In most of the county the water is of good quality for drinking and for irrigating small gardens. Some dissolved gypsum occurs in the water in the southwest and west. Such water has an unpleasant taste but is not harmful. The supply of underground water is not enough for irrigating large tracts, except possibly in the large bend of the Arkansas River at the northeastern corner of the county.

Much of the water for livestock in the cattle-ranching sections is supplied by artificial ponds. The capacity of these ponds ranges from 1 to 15 acre-feet and averages 4 acre-feet. An estimated 300 to 400 ponds have been built recently through sponsorship of Federal and State agencies. The ponds hold water very well where the underlying formation is clay or shale but not so well where the formation is sandy.

Perry obtains its water from a reservoir on Cow Creek, 4 miles southwest of the city. Billings, Red Rock, Marland, and Morrison get water from large, moderately shallow wells on bottom lands along large nearby streams.

NATIVE VEGETATION

The native vegetation consists principally of mixed tall and short grasses. There are three distinct associations in the county.

The first association, the typical prairie type, occurs on the silt loam, loam, and clay loam soils of the uplands. When the county was first settled, the association was dominated by little bluestem. Associated with the little bluestem were big bluestem, sand bluestem, silver beardgrass, side-oats grama, blue grama, and buffalograss. Grazing has eliminated most of the tall bunchgrasses. Now the dominating vegetation in pastures is buffalograss, blue grama, and side-oats grama. Bluestem grasses persist in meadows, along ungrazed roadsides, and on well-managed grazing land in the eastern and southern parts of the county.

The second plant association occupies deep and loose sandy soils in the northeastern part. This area, surrounded on three sides by the Arkansas River, is locally called big bend country. This second plant association is also on shallow sandy soils in the southern part of the county. Post and blackjack oaks are dominant. Associated with the oaks are little bluestem, sand bluestem, Indiangrass, various panicums, Johnsongrass, field sandbur, and hairy grama.

The third plant association occurs along the streams on alluvial soils. It consists of American elm, chinquapin, post, and blackjack oaks, hackberry, gum-elastic, willow, cottonwood, green ash, and Chickasaw plum. Associated with the trees are several species of grass, principally bluestems. Common shrubs are the fragrant sumac, smooth sumac, roughleaf dogwood, poison ivy, and coralberry.

The grasses, trees, and woody plants common in the county are listed by scientific name as follows:

GRASSES

Scientific Name	*Common Name*
Andropogon scoparius	Little bluestem.
A. gerardi	Big bluestem.
A. hallii	Sand bluestem.
A. saccharoides	Silver beardgrass.
Bouteloua curtipendula	Side-oats grama.
B. gracilis	Blue grama.
B. hirsula	Hairy grama.
Buchloe dactyloides	Buffalograss.
Cenchrus pauciflorus	Field sandbur, or grassbur.
Sorghastrum nutans	Indiangrass.
Sorghum halcpense	Johnsongrass.

TREES AND WOODY PLANTS

Scientific Name	*Common Name*
Bumelia lanuginosa	Gum-elastic, or chittam wood.
Celtis occidentalis var. *crassifolia*	Hackberry.
Cornus asperifolia	Roughleaf dogwood.
Fraxinus pennsylvanica var. *subintergerrima*	Green ash.
Populus deltoides var. *virginiana*	Cottonwood.
Prunus angustifolia	Chickasaw plum.
Quercus marilandica	Blackjack oak.
Q. muhlenbergii	Chinquapin oak.
Q. stellata	Post oak.
Rhus aromatica	Fragrant sumac.
R. glabra	Smooth sumac.
Symphoricarpus orbiculatus	Coralberry, or buckbrush.
Toxicodendron radicans	Poison ivy.
Ulmus americana	American elm.

GENERAL NATURE OF THE SOILS

The soils of Noble County are mainly of the Reddish Prairie great soil group. Most of them have developed under grass. The normal soils in smooth areas have fairly dark surface soils that are slightly to moderately acid and dominantly of medium texture. The normal soils, for the most part, have alkaline compact, very slowly permeable, clay subsoils. Table 2 lists the soil series of the county, and the parent material, vegetation, topography, and the nature of the surface soil and subsoil. For a detailed description of the important soil series, see the section, Some Representative Soils and Their Relations.

As a whole, the soils are fairly productive, though their fertility has been depleted by erosion and constant cropping. About 10 percent of the agricultural land in the county consists of soils that can be used for crops without safeguards against erosion. About 40 percent is suitable for cultivation if intensive conservation methods and related good soil management are practiced. An additional 32 percent can be cropped but requires contour cultivation of intertilled crops, use of the soils most of the time for erosion resistant crops, and other rather intensive measures for control of erosion. Except for small areas of forested sandy upland, some of which can be used for farm woodlots, the remaining 18 percent of the agricultural soils is best suited to permanent pasture or meadow.

Methods of controlling erosion, applying fertilizer, and other practices of management suitable for the soils are discussed in the section, Management of Noble County Soils.

TABLE 2.—*Characteristics of the soil series of Noble County, Okla.*

Series	Topography	Dominant slope	Vegetation	Parent material	Surface soil	Subsoil	Internal drainage
Albion	Upland	2– 8	Prairie	Old gravelly alluvium	Brown, friable, granular, acid; about 10 inches deep.	Reddish-brown or brown sandy or gravelly clay loam over gravel.	Rapid.
Calumet	Stream terraces	0– 1	Prairie	Limy clayey old alluvium	Grayish brown, friable, acid; about 10 inches deep.	Brown compact clay, a claypan.	Very slow.
Canadian	Low stream terraces.	0–5	Mostly tall grasses, some scattered trees.	Limy sandy alluvium	Grayish brown to brown, friable, neutral; 12 to 20 inches deep.	Brown or light-brown sandy loam or loam.	Rapid.
Chickasha	Upland	0–10	Prairie	Reddish, fine-grained, soft sandstone and sandy shale.	Brown, friable, granular, acid; about 8 inches deep.	Brown, granular, permeable clay loam; becomes heavier and splotched with red in lower part.	Medium.
Dale	High bottoms or low stream terraces.	0– 1	Prairie	Recent alluvial silt washed from acid prairies.	Dark grayish brown, friable, strongly granular, acid to neutral; about 18 inches deep.	Grayish-brown, friable, permeable loamy silt; neutral or alkaline.	Medium.
Darnell	Uplands	3–10	Post and blackjack oaks.	Reddish, fine-grained, nonlimy sandstone.	Light brown to brown, very friable; about 5 inches deep.	Light-brown or reddish-brown, very friable, acid sandy loam; overlies sandstone at 15 to 40 inches.	Rapid.
Derby	Upland or stream terraces.	3– 7	Post and blackjack oaks and tall grasses.	Eolian sand	Grayish brown, loose, slightly acid.	Pale-brown loose loamy sand	Very rapid.
Drummond	Upland or stream terraces.	0– 1	Sparse cover of grass or bare.	Limy clays, mostly reddish, and residuum from red shale.	Gray, crusty, very thin; silt loam or coarser in texture.	Gummy, intractable, nearly impervious clay.	Very slow or none.
Gowen	Flood plain	0– 1	Prairie	Recent loamy alluvium washed from acid prairies.	Dark grayish brown, friable, strongly granular, neutral; about 18 inches deep.	Grayish-brown, friable, permeable loam to clay loam.	Medium.
Kay	Low stream terraces.	0– 1	Prairie	Reddish limy clayey alluvium.	Nearly black, moderately granular, about neutral; 10 to 20 inches deep.	Dark-brown heavy clay	Slow.
Kirkland	Upland	0– 4	Prairie	Mostly limy red clays and soft shales.	Grayish brown to brown, friable acid; about 10 inches deep.	Brown compact clay; a claypan.	Very slow.
Lela	Low stream terraces.	0– 1	Prairie	Limy clayey alluvium	Nearly black, moderately granular, about neutral; 20 inches deep.	Brown to reddish-brown heavy clay.	Slow.
Lucien	Upland	3–10	Prairie	Red nonlimy soft sandstone interbedded with shale.	Reddish brown, friable, acid; 6 to 10 inches deep.	Red sandy loam or sandy clay loam over sandstone interbedded with shale at 12 to 30 inches.	Medium.

Miller	Flood plain	0- 1	Flood-plain forest	Reddish limy or alkaline clayey recent alluvium.	Reddish brown, limy or alkaline, granular.	Red or reddish-brown clay	Very slow.
Norge	Margins of upland flats.	1- 8	Prairie	Yellowish red limy or alkaline alluvial or eolian silts and sandy clays.	Brown to reddish brown, friable, granular, acid; 10 to 15 inches deep.	Reddish brown silty clay loam grading to firm silty or sandy clay at about 25 inches.	Medium.
Owens	Upland	5-10	Prairie	Gray and yellow limy shale	Grayish brown, granular, limy, 3 to 8 inches deep.	Yellowish or olive-gray limy clay over shale at 1 or 2 feet.	Very slow.
Port	High bottoms or low stream terraces.	0- 1	Flood-plain forest	Reddish neutral or alkaline loamy recent alluvium from prairies.	Brown to reddish brown, granular, friable; 15 to 20 inches deep.	Reddish-brown or red silt loam or silty clay loam; neutral or alkaline.	Medium.
Renfrow	Upland	1- 4	Prairie	Red limy or alkaline clays and soft shales.	Reddish brown to brown, acid, friable, moderately granular; 5 to 10 inches thick.	Reddish-brown or red, compact, very slowly permeable clay.	Very slow.
Sogn	Upland	5-30	Prairie	Limestone interbedded with shale.	Dark grayish brown, granular, neutral or limy; thin.	Grayish-brown granular clay over limestone at 6 to 20 inches.	Medium to slow.
Stephenville	Gently to moderately sloping.	3-10	Post and blackjack oaks.	Reddish, nonlimy, soft sandstone or sandy shale.	Brown above light brown or light reddish brown, very friable, acid; 5 to 10 inches deep.	Yellowish-red to red or light reddish-brown, friable, permeable, acid sandy clay loam underlain by sandstone at 18 to 40 inches.	Rapid.
Summit	Upland	1- 3	Prairie	Limy yellowish clay and shale, interbedded with thin limestone.	Nearly black, granular, about neutral; 10 to 15 inches deep.	Grayish-brown granular clay over yellowish slowly permeable clay at about 25 inches.	Medium
Tabler	Upland flats	0- 3	Prairie	Limy clays or shales, mostly reddish.	Grayish brown, acid, friable; 10 to 14 inches deep.	Dark-gray compact clay, a distinct very slowly permeable claypan.	Very slow.
Vanoss	Upland flats	0- 1	Prairie	Yellowish-red, alkaline or limy, eolian or alluvial silts.	Brown, friable, granular, acid; 12 to 18 inches deep.	Brown, granular, permeable silty clay loam grading into compact clay at about 3 feet.	Medium.
Vernon	Upland	4-10	Prairie	Red alkaline or limy clay and soft shale.	Reddish brown, neutral or limy, granular; 2 to 6 inches deep.	Red firm clay over raw clay or shale at 10 to 25 inches.	Very slow.
Yahola	Flood plain	0- 1	Flood-plain forest	Reddish, neutral, or alkaline, loamy recent alluvium from prairies.	Reddish brown or red, neutral to limy, friable.	Red or reddish-brown permeable loam, sandy loam, or clay loam.	Medium to rapid.

SOIL SURVEY METHODS AND DEFINITIONS

The scientist who makes a soil survey examines soils in the field, classifies the soils in accordance with facts he observes, and maps their boundaries on an aerial photograph or other map.

Field study.—The soil surveyor bores or digs many holes to see what the soils are like. The holes are not spaced in a regular pattern, but are located according to the lay of the land. Usually they are not more than a quarter of a mile apart and sometimes they are much closer. In most soils such a boring or hole reveals several distinct layers, called horizons, which collectively are known as the soil profile. Each layer is studied to see how it differs from others in the profile and to learn the things about the soil that influence its capacity to support plant growth.

Color is usually related to the amount of organic matter. The darker the surface soil, as a rule, the more organic matter it contains. Streaks and spots of gray, yellow, and brown in lower layers generally indicate poor drainage and poor aeration. In this report, color terms are for the dry soil unless otherwise stated.

Texture, or content of sand, silt, and clay, is determined by the way the soil feels when rubbed between the fingers and is later checked by laboratory analysis. Texture determines how well the soil retains moisture, plant nutrients, and fertilizer, and whether it is easy or difficult to cultivate. Coarse-textured soils contain much sand, and fine-textured soils contain much clay. In this report sandy soils may be referred to as light-textured, and clayey soils as heavy-textured.

Structure, which is the way the individual soil particles are arranged in larger grains and the amount of pore space between grains, gives us clues to the ease or difficulty with which the soil is penetrated by plant roots and by moisture.

Consistence, or the tendency of the soil to crumble or to stick together, indicates whether it is easy or difficult to keep the soil open and porous under cultivation. Some terms used to describe consistence are "friable, plastic, sticky, hard, compact, tough, cemented."

Permeability refers to the ease with which water, air, and roots penetrate.

Surface soil refers to the surface layer, which normally extends to depths of 6 to 12 inches.

Subsoil is the layer, or layers, under the surface soil. In many soils it is decidedly firmer and contains more clay than the surface soil.

Substratum, the material beneath the subsoil, characteristically is raw material not yet changed into a soil horizon.

Bedrock is the consolidated rock underlying the soil or outcropping in places.

Reaction shows degree of acidity, and, in a practical sense, can be considered the degree of poverty in lime. Neutral or alkaline soils contain enough available lime for growth of alfalfa, sweetclover, and similar legumes. Acid soils need lime, the amount depending on their degree of acidity. The reaction of a soil is expressed in pH values. A pH of 7.0 indicates precise neutrality; higher values, alkalinity, and lower values, acidity. Terms referring to reaction commonly used in soil surveying are as follows:

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5–5.0
Strongly acid	5.1–5.5
Medium acid	5.6–6.0
Slightly acid	6.1–6.5
Neutral	6.6–7.3
Mildly alkaline	7.4–7.8
Moderately alkaline	7.9–8.4
Strongly alkaline	8.5–9.0
Very strongly alkaline	9.1 and higher.

Other characteristics observed in the course of field study and considered in classifying the soil include the following: The depth of the soil to bedrock or compact layers; the presence of gravel or stones in amounts that will interfere with cultivation; the steepness and pattern of slopes; and the degree of erosion.

Classification.—On the basis of characteristics observed by the survey team or determined by laboratory tests, soils are classified into phases, types, and series. The soil type is the basic classification unit. A soil type may consist of several phases. Types that resemble each other in most of their characteristics are grouped into soil series.

As an example of soil classification, consider the Renfrow series of Noble County. This series is made up of two soil types, subdivided into phases, as follows:

Series	*Type*	*Phase*
Renfrow	silt loam	1 to 2 percent slopes.
		2 to 4 percent slopes.
		eroded, 2 to 4 percent slopes.
	silty clay loam	2 to 4 percent slopes.
		eroded, 2 to 4 percent slopes.

Soil type.—Soils similar in kind, thickness, and arrangement of soil layers are classified as one soil type.

Soil phase.—Because of differences other than those of kind, thickness, and arrangement of layers, some soil types are divided into two or more phases. Slope variations, frequency of rock outcrops, degree of erosion, depth of soil over the substratum, or natural drainage are examples of characteristics that suggest dividing a soil type into phases.

The soil phase (or the soil type if it has not been subdivided) is the unit shown on the soil map. It is the unit that has the narrowest range of characteristics. Use and management practices therefore can be specified more easily than for soil series or yet broader groups that contain more variation.

Soil series.—Two or more soil types that differ in surface texture, but are otherwise similar in kind, thickness, and arrangement of soil layers, are normally designated as a soil series. In a given area, however, it frequently happens that a soil series is represented by only one soil type. Each series is named for a place near which it was first mapped.

Miscellaneous land types.—Fresh stream deposits or rough, stony, and severely gullied lands that have little true soil are not classified into types and series, but are identified by descriptive names, such as Rough broken land, Vernon soil materials, 10+ percent slopes.

Soil complex.—When two or more soils are so intricately associated in small areas that it is not practical to show them separately on the soil map, they are mapped together and called a soil complex. Calumet-Drummond silt loams, 0 to 1 percent slopes, is a soil complex mapped in this county.

DESCRIPTIONS OF THE SOILS

The soils of the county are described in this section, and their agricultural relations are discussed. The soils are arranged in alphabetic order, by soil series names. Table 3 shows the approximate acreage of each soil, and the estimated percentages used for cultivated crops, pasture, woodlots, and miscellaneous purposes. The accompanying soil map shows the boundaries of the different kinds of soil.

Albion loam, 2 to 5 percent slopes (AA).—This medium-deep friable soil of the prairies is underlain by porous gravelly material. It occupies low ridges and moderate slopes on fairly high divides, mainly along the north side of Black Bear Creek, and to some extent along the north side of Red Rock Creek. Two-thirds or more of this soil has slopes of 2 to 5 percent; the extreme range is from 2 to 8 percent. The tracts are small and are associated with the Norge and Vanoss soils.

The surface soil, 10 to 12 inches deep, is a brown friable loam that grades into a reddish-brown, gritty loam upper subsoil. The subsoil below depths of 1½ to 2 feet is a mixture of about equal parts of fine earth and waterworn gravel. Albion loam differs from Norge soils in having porous gravelly material within a depth of less than 3 feet.

Much of this soil is used for pasture and hay, although about 23 percent is cultivated. Of the cultivated land, about 50 percent is cropped to wheat, 10 percent to oats, and 35 percent to sorghums. About 5 percent is in miscellaneous crops, including cotton, corn, and Sudangrass.

This soil is only moderately suited to crops because it has a low water-holding capacity. Erosion is minor on most of this soil, however, and is especially active only on the areas having slopes of more than 5 percent. The best use for much of this soil probably is for pasture. Some areas are used as a source of gravel.

Albion loam, eroded, 5 to 8 percent slopes (AB).—This soil is like Albion loam, 2 to 5 percent slopes, except it has a shallower surface soil that has been thinned by erosion under cultivation. In most places the remaining surface soil is 6 to 8 inches thick, but there are places where all but 2 to 4 inches has been lost. As a whole this soil is somewhat more sloping and susceptible to erosion than Albion loam, 2 to 5 percent slopes.

With proper management this soil can be farmed safely and will produce moderate yields. Generally, however, it is some of the least productive, most erodible cropland. Except for isolated areas surrounded by better soils used for crops, the most profitable use of this

TABLE 3.—*Approximate acreage, proportionate extent, and use distribution of the soils mapped in Noble County, Okla.*

Soil	Extent		Use distribution			
	Acres	Percent	Cultivated	Pasture [1]	Woodland	Miscellaneous [2]
			Percent	*Percent*	*Percent*	*Percent*
Albion loam, 2 to 5 percent slopes	3, 338	0. 7	23	72	0	5
Albion loam, eroded, 5 to 8 percent slopes	417	. 1	25	70	0	5
Broken land, Reinach soil material, 20+ percent slopes	4, 374	. 9	26	15	54	5
Calumet silty clay loam, 0 to 1 percent slopes	1, 110	. 2	88	7	0	5
Calumet-Drummond silt loams, 0 to 1 percent slopes	2, 724	. 5	73	22	0	5
Canadian fine sandy loam, 0 to 3 percent slopes	645	. 1	51	13	31	5
Canadian fine sandy loam, 3 to 5 percent slopes	1, 024	. 2	33	25	37	5
Chickasha loam, 0 to 3 percent slopes	2, 766	. 6	27	68	0	5
Chickasha loam, 3 to 5 percent slopes	11, 829	2. 5	51	44	0	5
Chickasha loam, eroded, 3 to 5 percent slopes	2, 099	. 4	27	68	0	5
Chickasha loam, 5 to 10 percent slopes	3, 692	. 7	21	74	0	5
Chickasha loam, eroded, 5 to 10 percent slopes	4, 953	1. 0	58	37	0	5
Dale silt loam, 0 to 1 percent slopes	7, 772	1. 6	78	17	0	5
Darnell-Stephenville fine sandy loams, 3 to 10 percent slopes	5, 463	1. 2	8	38	37	5
Derby loamy fine sand, 3 to 7 percent slopes	1, 030	. 2	28	30	37	5
Gowen silt loam, 0 to 1 percent slopes	9, 998	2. 0	44	46	5	5
Gowen silty clay loam, 0 to 1 percent slopes	5, 561	1. 2	29	40	26	5
Kay silty clay loam, 0 to 1 percent slopes	5, 514	1. 2	77	18	0	5
Kirkland silt loam, 0 to 2 percent slopes	70, 848	14. 9	74	21	0	5
Kirkland silt loam, 2 to 4 percent slopes	10, 861	2. 3	59	36	0	5
Kirkland silt loam, eroded, 2 to 4 percent slopes	12, 081	2. 6	65	30	0	5
Lela clay, 0 to 1 percent slopes	1, 008	. 2	88	7	0	5
Lucien stony loam, 3 to 10 percent slopes	1, 089	. 2	15	80	0	5
Lucien very fine sandy loam, 3 to 5 percent slopes	21, 121	4. 4	26	69	0	5
Lucien very fine sandy loam, 5 to 10 percent slopes	8, 626	1. 8	12	83	0	5
Lucien very fine sandy loam, eroded, 5 to 8 percent slopes	9, 363	2. 0	41	54	0	5
Miller clay, 0 to 1 percent slopes	809	. 2	68	9	18	5

See footnotes at end of table.

Table 3.—*Approximate acreage, proportionate extent, and use distribution of the soils mapped in Noble County, Okla.*—Continued

Soil	Extent		Use distribution			
	Acres	Percent	Cultivated	Pasture[1]	Woodland	Miscellaneous[2]
			Percent	*Percent*	*Percent*	*Percent*
Miller silty clay loam, 0 to 1 percent slopes	374	0. 1	31	46	18	5
Norge silt loam, 1 to 5 percent slopes	37, 613	7. 8	62	33	0	5
Norge silt loam, eroded, 1 to 5 percent slopes	1, 905	. 4	66	29	0	5
Norge silt loam, 5 to 8 percent slopes	4, 735	1. 0	33	62	0	5
Norge silt loam, eroded, 5 to 8 percent slopes	4, 605	1. 0	58	37	0	5
Oil-waste land	1, 394	. 3	0	0	0	100
Owens clay, 5 to 10 percent slopes	2, 335	. 5	36	59	0	5
Port silt loam, 0 to 1 percent slopes	28, 164	5. 9	85	7	3	5
Port silty clay loam, 0 to 1 percent slopes	8, 496	1. 8	85	7	3	5
Renfrow silt loam, 1 to 2 percent slopes	2, 162	. 4	72	23	0	5
Renfrow silt loam, 2 to 4 percent slopes	39, 704	8. 4	47	48	0	5
Renfrow silt loam, eroded, 2 to 4 percent slopes	4, 780	1. 0	56	39	0	5
Renfrow silty clay loam, 2 to 4 percent slopes	1, 858	. 4	34	61	0	5
Renfrow silty clay loam, eroded, 2 to 4 percent slopes	250	. 1	27	68	0	5
Rough broken land, Norge soil material, 10+ percent slopes	1, 259	. 2	18	52	25	5
Rough broken land, Vernon soil material, 10+ percent slopes	31, 028	6. 5	5	90	0	5
Rough stony land, Darnell soil material, 10+ percent slopes	4, 699	. 9	0	26	69	5
Sogn stony clay loam, 5 to 30 percent slopes	1, 489	. 3	0	95	0	5
Summit silty clay loam, 1 to 3 percent slopes	2, 309	. 5	48	47.	0	5
Tabler silt loam, 0 to 1 percent slopes	28, 941	6. 1	85	10	0	5
Tabler silt loam, eroded, 1 to 3 percent slopes	2, 153	. 4	70	25	0	5
Vanoss silt loam, 0 to 1 percent slopes	8, 559	1. 8	87	8	0	5
Vernon clay loam, 4 to 10 percent slopes	26, 112	5. 5	27	68	0	5
Yahola silt loam, 0 to 1 percent slopes	20, 412	4. 3	39	34	22	5
Water	2, 629	. 5	-----	-----	-----	-----
Total (land and water)	478, 080	100. 0	52	39	4	5

[1] Includes idle cropland, not cultivated in 1939.
[2] Nonagricultural land.

soil is for pasture. The soil is suited to the same crops as Albion loam, 2 to 5 percent slopes, but prevailing yields are lower, possibly only two-thirds as high.

Broken land, Reinach soil material, 20+ percent slopes (BA).—This unit occurs on narrow steep escarpments of low stream terraces occupied by Port and associated soils. It is fertile alluvial land unsuited to crops because of topography, but excellent for pasture grasses and trees. It is a good soil for farm woodlots or permanent pasture.

Most areas have a somewhat darkened surface soil, commonly 8 to 18 inches deep, of brown friable silt loam or loam. This surface soil is similar to that of Reinach silt loam, the soil with which these areas would be classified if the surface were not so broken. Below the surface soil are loamy, somewhat stratified, friable, alkaline or calcareous, more or less reddish, alluvial deposits.

Commonly areas of this land are on narrow slopes that lead down from the second bottoms of Port soils to the flood plains, or first bottoms, which are largely covered by Yahola soils. A few areas occur on the escarpments of high stream terraces. The principal bodies are in the valleys of Black Bear Creek, Red Rock Creek, and the Arkansas River. Slopes range from 20 to 100 percent; surface drainage is very rapid, and a large part of the rainfall is lost as runoff.

Much of this land type is wooded with elm, cedar, red oak, white oak, post oak, and blackjack oak. These areas are used as farm woodlots that supply firewood and fence posts. The rest is native grassland that supports mainly bluestem and grama grasses and is used principally for pasture. None of the land is cultivated. Some areas are so narrow that pasturing, which generally requires fencing, is not practical. These areas are idle.

Calumet silty clay loam, 0 to 1 percent slopes (CB).—This moderately acid soil occurs on level stream terraces along Red Rock and Black Bear Creeks and some of their tributaries. Surface drainage is very slow but generally adequate for successful cultivation. The surface soil, a brown or dark grayish-brown friable silty clay loam, is 10 to 14 inches deep over a brown or dark grayish-brown claypan. The soil resembles the Kirkland silt loams rather closely but has somewhat finer textured surface soil, occurs on benches or second bottoms along streams, and is underlain by brownish alluvial clays that contain a few waterworn pebbles, rather than by red shales.

The soil is very slowly permeable but has a fairly high water-holding capacity. It has developed from old alluvium that originated mainly on humid prairies underlain by red beds.

The natural vegetation is mainly bluestem and grama grasses. Much of the soil is cultivated. Only about 17 percent is in pasture and meadow. Of the cultivated land about 75 percent is cropped to wheat, 15 percent to oats, 5 percent to sorghums, and 5 percent to alfalfa.

The soil is well suited to crops, but more suited to small grains than to most other common field crops. It is somewhat too wet in cool seasons for best growth of corn or alfalfa, and somewhat droughty during the summer. Erosion is not a problem. Average yields could be increased one-fourth to one-half by good soil management, including systematic rotation of other crops with a legume and application of phosphate fertilizer.

Calumet-Drummond silt loams, 0 to 1 percent slopes (Ca).—This mapping unit is a mixture of Calumet silt loam, a soil well suited to crops, especially small grains, and many included patches, commonly known as slick spots, of Drummond silt loam, a nearly barren, almost worthless soil.

This unit is imperfectly drained. It is suited to cultivation but its value for crops varies with the amount of Drummond silt loam present. The slick spots of Drummond silt loam are roundish and 10 to 50 feet in diameter. Collectively they make up 5 to 20 percent of the area in most places, but in no place are they so abundant that they cover half the surface or render the unit unsuitable for crops.

The Calumet silt loam covers about 80 to 95 percent of this unit; it is much like the Kirkland silt loam and has similar crop adaptations, productivity, use capabilities, and requirements for management. The Drummond silt loam of this unit is the same as the soil condition described separately in this section under the heading, Slick Spots.

This complex has developed from alluvium on level stream terraces that lie above ordinary overflow. It is associated with Port and Lela soils, mainly on the terraces of Red Rock and Black Bear Creeks. The natural vegetation is mainly bluestem and grama grasses.

Approximately 73 percent of this unit is in crops; nearly all the rest is pastured. Of the cultivated land, about 75 percent is cropped to wheat, 15 percent to oats, and 5 percent to alfalfa. The rest is used for barley, millet, sorghums, and other crops. Yields vary greatly from place to place, depending largely on the percentage of slick spots.

Canadian fine sandy loam, 0 to 3 percent slopes (Cd).—This soil is the dark sandy land of the benches along the Arkansas River in the northeastern part of the county. It is moderately fertile. Water erosion is not a problem; the soil is somewhat susceptible to blowing. It is adapted to a wide variety of crops because it is deep, rapidly permeable, well drained, and easily worked.

The surface soil is 12 to 20 inches of neutral or alkaline, grayish-brown, very friable fine sandy loam. The subsoil is light-brown fine sandy loam. Below 30 inches begins the substratum, which is generally light yellowish-brown fine sandy loam but locally may have layers of silt loam or light clay loam.

This soil includes a few areas of closely related soils having surface layers and subsoils of silt loam, loam, or very fine sandy loam. The inclusions have agricultural use and value like or slightly superior to those of this soil. The included areas collectively cover above 300 acres.

Canadian fine sandy loam, 0 to 3 percent slopes, is rapidly permeable to water, air, and roots and has a moderate water-holding capacity. Little water runs off, but some percolates beyond the reach of crop roots. The soil occupies nearly level or gently undulating stream terraces and is well drained. The associated more sandy areas are Derby loamy fine sand, 3 to 7 percent slopes.

About 50 percent of this soil is cultivated, and it is productive. Most of the remaining area is forest, but grass grows thick beneath the trees. Of the cultivated land, about 20 percent is cropped to corn, 10 percent to alfalfa, 10 percent to sorghums, 40 percent to wheat, and

10 percent to oats; the rest is used for other crops, including cotton, fruit, and vegetables.

This soil is well suited to cultivation and will likely stay productive a long time. Erosion is not a problem. A diversified type of agriculture is practiced. Crops are alternated but no systematic rotation of crops is followed.

Yields of most crops no doubt could be increased by using rotations that include a legume. Alfalfa, cowpeas, vetch, sweetclover, and soybeans are among the better legumes for this soil (pl. 1).

Canadian fine sandy loam, 3 to 5 percent slopes (Cc).—Except for its greater slopes, this soil is the same as Canadian fine sandy loam, 0 to 3 percent slopes. The dominant gradient is about 5 percent; because of this, the soil is susceptible to water erosion.

Use, productivity, and management requirements are almost the same as for Canadian fine sandy loam, 0 to 3 percent slopes. Contour farming and stripcropping are of especial value in preventing soil washing and blowing.

Chickasha loam, 3 to 5 percent slopes (CE).—This loamy soil is medium deep to deep, permeable, moderately fertile but acid, easily worked and well drained. It covers gently sloping areas of prairie that are underlain by somewhat reddish, interbedded, soft, noncalcareous sandstones and sandy shales of neutral or alkaline reaction.

The soil is permeable to roots, air, and water and has a high water-holding capacity except in more shallow areas. It is easy to work and keep in good tilth.

The soil is extensive in the central-southern and southwestern parts of the county. Associated soils are mainly other phases of Chickasha loam and the Lucien and Darnell soils.

This soil covers smooth gently sloping areas, mostly on stream divides. Both surface and internal drainage are rapid. The natural vegetation is mainly bluestem, sideoats grama, and blue grama. A few elm, haw, and hackberry trees grow in places.

The surface soil is a brown, acid, friable loam, 7 to 12 inches deep over a friable permeable clay loam subsoil. The upper part of the subsoil is brown and nearly or completely free from mottling. The lower part of the subsoil, that below 15 to 20 inches, is splotched or coarsely mottled with yellowish red. The depth to bedrock ranges between 30 and 70 inches. A detailed description of a typical profile is given in the section, Some Representative Soils and their Relationships.

About 50 percent of the soil is in crops; nearly all the rest is in native pasture. Of the cultivated land, about 10 percent is cropped to cotton, 5 percent to corn, 15 percent to oats, 60 percent to wheat, and 10 percent to sorghums.

The soil is productive and well suited to cultivation but tends to erode if improperly used or managed. Contour cultivation of intertilled crops is essential. A suitable rotation should include a legume and consist mainly of crops that will keep the soil covered at least half the time. A plant cover is especially needed in areas that have been cropped for many years.

Yields probably could be greatly increased by using a rotation that includes alfalfa, sweetclover, or a similar legume and by fertilizing with phosphorous or barnyard manure. Areas not already treated in this way require liming before legumes such as sweetclover or alfalfa will thrive.

Chickasha loam, eroded, 3 to 5 percent slopes (CF).—This soil is the same as Chickasha loam, 3 to 5 percent slopes, but is more eroded. The remaining surface soil is from 3 to 7 inches thick. From one-fourth to three-fourths of the original surface soil has been lost through erosion. The areas are crossed by numerous rills and shallow gullies. A few deep gullies have formed where runoff has been diverted from its natural course onto land not protected by permanent grass.

The fertility of most of this soil has been greatly reduced by erosion and probably cannot be restored. Included within the soil as mapped are many small areas, totaling about 10 percent, which are so severely eroded that little or none of the original surface soil remains. The clay loam subsoil is either exposed or constitutes most of the material within the plow depth.

About two-thirds of this soil is idle or in abandoned-field pasture that has very low carrying capacity. Average yields are about two-thirds those obtained on Chickasha loam, 3 to 5 percent slopes.

Chickasha loam, 0 to 3 percent slopes (CG).—This soil differs from Chickasha loam, 3 to 5 percent slopes, only in being less sloping and having surface gradients of less than 3 percent. The gentler relief results in less tendency to erode and less loss of water as runoff.

The principal areas of this soil are in the central-south and southwestern parts. Erosion is only a minor problem and easy to control. About 80 percent of the soil is in cultivation; it is planted to the same crops as Chickasha loam, 3 to 5 percent slopes. Yields are the same or slightly higher.

Chickasha loam, 5 to 10 percent slopes (CH).—This soil is like Chickasha loam, 3 to 5 percent slopes, except it is more sloping and therefore more likely to erode. It is poorly suited to intertilled crops. The slopes are such that control of erosion is difficult and expensive if row crops are grown. Permanent pasture or meadow is generally more profitable and better for the land.

About 20 percent of this soil was cultivated at the time of survey; the rest was in native pasture or meadow. All of the cultivated area showed some erosion. At time of survey, however, the loam surface soil had not been reduced to an average of less than 7 inches. The principal cultivated crops are wheat, oats, and sorghums for hay.

Chickasha loam, eroded, 5 to 10 percent slopes (CK).—This soil is similar to Chickasha loam, eroded, 3 to 5 percent slopes. The greater slopes, however, make it more susceptible to erosion and more severely eroded. Consequently, intertilled erosion-promoting crops are unfit or poorly suited. About 37 percent of the soil is so severely eroded that the subsoil is exposed or the surface soil is less than 3 inches deep. The remaining area is moderately eroded and has surface soil 3 to 7 inches deep.

About 60 percent of the soil was cultivated at the time of survey, mainly the less sloping and less eroded parts. Since that time much of the acreage has been taken out of cultivation. The principal cultivated crops are wheat, oats, and sorghums for forage. Yields are usually about one-half to two-thirds as much as those obtained on Chickasha loam, 3 to 5 percent slopes. All areas of this soil have been cultivated at one time or another. Those now retired from cropping are mostly in weedy unproductive pasture or idle.

Dale silt loam, 0 to 1 percent slopes (DA).—This deep, fertile, permeable, easily worked soil occurs in high bottoms along local streams that drain prairies. It is less reddish than Port silt loam but otherwise resembles that soil very closely.

This soil consists of alluvial silts deposited by the adjoining streams; it has no sharp layering of surface soil and subsoil, though the upper part is distinctly darkened by accumulation of organic matter. The surface soil is dark grayish-brown to brown friable silt loam. Similar material continues to a depth of about 15 inches, where the color gradually becomes slightly less dark (grayish brown to rather light brown) because there is a decreasing amount of organic matter.

The soil is permeable, has a high water-holding capacity, and is of about neutral reaction. It is comparatively rich in organic matter and plant nutrients. Relative to the stream channels, the areas lie at the same level as the Port soils. They are rarely overflowed, or about once in 15 to 30 years. The natural vegetation is mainly bluestem and grama grasses.

Approximately 80 percent of this soil is cultivated; almost all the rest is native pasture. Of the cultivated land, about 50 percent is cropped to wheat, 15 percent to oats, 10 percent to cotton, 5 percent to alfalfa, and 20 percent to corn. The soil is productive for general crops and alfalfa.

Darnell-Stephenville fine sandy loams, 3 to 10 percent slopes (DB).—This is a complex mixture of forested, reddish, acid, sandy soils ranging from shallow to deep over soft sandstones. The depth to sandstone varies from as little as 10 inches to greater than 30 inches. In many places, furthermore, the entire range in depth occurs more than once within a distance of 100 yards.

The shallow Darnell fine sandy loam, which has no distinctly heavier subsoil, generally has a few inches of brown, acid, fine sandy loam at the surface. The surface layer grades to light-brown or light reddish-brown fine sandy loam, which in turn gives way to partly weathered soft sandstone at depths ranging from 8 to 24 inches.

The deeper Stephenville fine sandy loam has surface and subsurface layers similar to the Darnell, but in addition, has a distinctly finer textured subsoil. This subsoil, a friable yellowish-red sandy clay loam, is underlain by sandstone, commonly at 20 to 40 inches below the surface.

About one-half of this unit is shallow Darnell soil; one-third is deeper Stephenville soil; and the rest is small included areas of Darnell stony loam, Chickasha loam, and several other associated soils.

This soil complex covers rolling forested sandy upland underlain by sandstones; it is poorly suited to crops. The soils are of such low natural fertility, are so intermixed with areas shallow to sandstone, and are so very erodible that they are not suited to intertilled crops. They are best used for permanent pasture or as farm woodlots.

Parts of this unit can be included in cropped areas of better soils to avoid inconveniently shaped fields. Many small areas, nearly always less than 5 acres, that have 2 feet or more of soil over sandstone can be used profitably for vegetables and orchard crops.

Areas that have been cleared and cropped amount to about 1,000 acres, or one-fifth of this unit. About one-third of this 1,000 acres has been severely eroded, and the rest is moderately eroded. Approximately 500 acres is still cultivated, mainly to cotton, sorghums, and corn. Yields vary widely, depending on management, length of time the land has been in cultivation, severity of erosion, and proportions of the soils shallow or deep over sandstone.

Yields could be more than doubled by use of a suitable rotation and fertilization, but most of this land probably should be reseeded to native grasses. Grasses will not grow well in some of the badly gullied areas unless they receive barnyard manure or crop residues.

Derby loamy fine sand, 3 to 7 percent slopes (Dc).—This nonarable, loose, deep, very sandy soil occurs within the bend of the Arkansas River in the northeastern part of the county. It consists of sands carried in by the Arkansas and drifted by wind into low ridges and dunes. The dunes and ridges are on both the second bottom and the adjacent parts of the upland.

The surface soil, a grayish-brown loose loamy fine sand, grades to pale-brown or light yellowish-brown loose loamy fine sand at depths of 7 to 15 inches. On the second bottom, the soil is neutral, but in areas farther from the Arkansas, or on the upland, it is acid.

About 28 percent of this soil is in cultivation. The rest is woodland pasture of low carrying capacity.

Gowen silt loam, 0 to 1 percent slopes (Ga).—This is a dark, deep, friable, very fertile, well-drained, alluvial soil. It occurs on first bottoms of local streams that drain the Kirkland soils and other mostly dark soils of the northwestern part of the county. It is almost the same as Port silt loam except for being less reddish. It consists of recent alluvial silts deposited during floods and lacks distinct surface soil and subsoil layers.

Characteristically, this soil has a dark grayish-brown friable silt loam surface soil neutral in reaction. This silt loam continues to a depth of about 18 inches, where the color becomes lighter and slightly browner. The profile is weakly stratified. Many areas have a surface layer, up to a foot thick, that consists of brown very recent alluvium deposited since areas further upstream were placed in cultivation. A detailed description of a representative profile is given in the section, Some Representative Soils and Their Relationships.

The areas of this soil are on flood plains 100 to 500 feet wide, through which the river meanders. Much of the soil near the channel is cut into small and irregular patches. These strips and patches are not suited to cropping under the extensive type of agriculture that prevails.

The natural vegetation is mainly grama and buffalo grasses, and trees along the stream channel. Approximately 44 percent of this soil is in crops, 46 percent in pasture, and 5 percent in woods. The cultivated areas are cropped mainly to wheat and oats. So far as is now known, this soil has practically the same crop adaptations, management requirements, and productivity as Port silt loam.

Gowen silty clay loam, 0 to 1 percent slopes (GB).—This very fertile alluvial soil is dark, well-drained, moderately fine textured, and easily worked. It lies in the narrow bottoms of small stream valleys that drain the dark soils in the northwestern part of the county. Almost all of it is near Billings.

The surface soil, a grayish-brown, friable, granular silty clay loam about neutral in reaction, extends without visible change to a depth of about 18 inches. Below this the soil material is slightly less dark and often weakly stratified, but otherwise much like the surface soil.

This soil is moderately permeable and has a high water-holding capacity. The flood plains in which it lies are almost level, but meandering stream channels cut the areas into small plots hardly large enough for any crops except vegetables. The soil is therefore used mainly for pasture. The natural vegetation is mainly buffalo and grama grasses. About 29 percent is cultivated; wheat and oats are the main crops. The soil would be satisfactory for general crops and alfalfa if it occurred in areas of a size suitable for their production.

Kay silty clay loam, 0 to 1 percent slopes (KB).—This is a dark, deep, very fertile but imperfectly drained soil. It is darker and more slowly drained than the associated Port soils, but nevertheless drainage is good enough to permit high yields.

To depths of 10 to 18 inches the surface soil is dark grayish-brown or very dark-brown friable silty clay loam. Below this is a dark-brown clay loam, often very faintly mottled with other colors. The clay loam gradually becomes finer textured and more reddish with depth. The lower subsoil, below 30 inches, is reddish-brown slowly permeable clay, locally stratified with silt.

The texture of the subsoil varies. The upper subsoil, between depths of 10 and 30 inches, is silty clay loam in some places and clay in others. The areas of silty clay loam subsoil are generally slightly better drained. The soil is neutral to mildly alkaline; the surface soil is noncalcareous and the deep subsoil is calcareous.

This soil lies on level low benches along the Salt Fork of the Arkansas River and along Black Bear and Red Rock Creeks. Runoff is very slow. The lower subsoil is slowly permeable clay, so internal drainage is slow. During wet seasons drainage is not adequate for best growth of crops. There is no erosion hazard; in fact, ditching to remove excess water may benefit yields in some areas.

Approximately 80 percent of the soil is in cultivation; nearly all the rest is in native pasture. Of the cultivated land, about 5 percent is cropped to corn, 65 percent to wheat, 15 percent to oats, 5 percent to sorghums, and 10 percent to alfalfa. The soil is very productive and will probably continue to be for a long time.

Increased yields probably could be had by use of crop rotations that include a legume. Yields of many crops, and especially of alfalfa, probably could be increased by ditching to remove excess water. Good yields are obtained without fertilization, but use of phosphorus might increase yields, especially of alfalfa.

Kirkland silt loam, 0 to 2 percent slopes (KE).—This soil, locally called hardland or wheatland, is the most extensive in Noble County. It covers about 15 percent of the county. The broad nearly level areas are on the upland in the northwest. Smaller areas are widely distributed in other sections.

The surface soil, a brown to grayish-brown friable silt loam, averages about 10 inches deep but ranges from 7 to 14 inches deep. It is underlain by a dark-brown or brown, compact, very slowly permeable claypan. With depth, the soil gradually becomes less dark and less acid. At about 2 feet it grades into reddish-brown calcareous clay which, in turn, grades at 4 to 6 feet into red calcareous shaly clay. A more detailed description of a representative profile appears in the section, Some Representative Soils and Their Relationships.

The soil is fairly permeable to roots, especially roots of small grains and native grasses, but is slowly permeable to water. Air appears to penetrate somewhat rapidly, largely through cracks that form as a result of drying and shrinkage.

The soil absorbs much water and holds it for a long time during winter. Water penetrates the subsoil slowly, but the nearly level topography favors retention of much of the rainfall. Surface and subsoil drainage are slow, but adequate for the growth of general crops. A few small depressions, sometimes called buffalo wallows, occur in virgin areas. The natural vegetation is a mixture of tall and short grasses, mainly bluestems, gramas, and buffalograss.

This soil occurs in association with other Kirkland soils and with Tabler and Renfrow soils, mainly in the northwestern part of the county. The soil is between Tabler and Renfrow soils in drainage and development. It usually occurs in areas between those soils.

About 74 percent of this soil is cropped; most of the rest is used for native pasture or meadow. Of the cultivated land, about 70 percent is cropped to wheat, 20 percent to oats, and 5 percent to sorghum. The rest is in miscellaneous crops such as millet, cotton, Sudangrass, and barley.

This soil is well suited to small grains, but during the hot summers is somewhat droughty for good yields of alfalfa or corn. Probably this soil can be cultivated to small grains for many years and will give moderate yields without fertilization other than with phosphorus, and possibly a little nitrogen.

Ordinarily, small grains are grown year after year. Yields no doubt could be increased by rotating cowpeas, sweetclover, or Austrian winter peas with the small grains and by adding lime and phosphorus. Special methods of retarding runoff and erosion are generally not used. Small grains cover the ground for all but about 3 or 4 months of the year and thereby protect it from erosion. A few farmers have built terraces on some of the more sloping areas. Terraces, once built, must be maintained.

Kirkland silt loam, 2 to 4 percent slopes (Kc).—This soil differs from Kirkland silt loam, 0 to 2 percent slopes, only in degree of slopes and greater tendency to erode.

Most of this soil is in the northwestern part of the county. Runoff is rapid. Internal drainage is very slow and never adequate for good growth of common field crops.

Because of this very slow permeability of the subsoil, and the gently sloping surface, some special way is needed to hold water on the soil until it is absorbed. Contour furrows, terracing, and crop-residue management help to do this.

About 60 percent of this soil is cultivated; most of the rest is native pasture or meadow. Of the cultivated land, about 70 percent is cropped to wheat, and 20 percent to oats. The rest is in a variety of crops, including barley, sorghums, and cotton.

Kirkland silt loam, eroded, 2 to 4 percent slopes (KD).—This soil covers those areas of Kirkland silt loam that have been modified by erosion to such an extent that only about 4 to 8 inches of surface soil remain. Rills or shallow gullies scar the areas, and there are some gullies more than a foot deep.

About 65 percent of this soil is cultivated, most of it to wheat. Yields will continue to decrease unless steps are taken to reduce loss of soil. In general, good treatment can still restore the soil productivity to a fair level.

Use of crop rotations that include a legume, practice of contour cultivation, and stripcropping so as to keep close-growing vegetation on the soil at least half of the time are of value. Terracing is needed to divert runoff from adjacent lands and to break the flow on long slopes. Addition of phosphorus and lime will increase the chances of success with sweetclover.

The areas indicated on the soil map as Kirkland silt loam, eroded, 2 to 4 percent slopes, include many scattered small bodies, totaling about 3,000 acres, which are so severely eroded that subsoil is exposed or the remaining silt loam surface soil is less than 3 inches deep. These are so severely damaged that reclamation for cropping is not economical and, in fact, hardly possible even at great cost. Wherever possible these areas should be retired to permanent grass. Buffalograss, gramas, and bluestems are the more commonly used for reseeding. Establishing a good plant cover is difficult and generally requires application of barnyard manure or of phosphorus and nitrogen fertilizer.

Lela clay, 0 to 1 percent slopes (KA).—This very dark, poorly drained but naturally fertile soil occurs on low level benches or flats above ordinary overflow along some of the smaller streams.

The surface soil is fine-textured but crumbly clay, very dark gray when dry but black when moist. Similar material continues to a depth of about 20 inches, where the color gradually changes to brown or reddish brown and the material becomes less granular and more nearly massive. The soil ranges from neutral to mildly alkaline in the surface layer. Below depths of 3 to 4 feet the material is calcareous.

This soil is only slowly permeable to water, and roots and air have some difficulty reaching the lower subsoil layer. The original vegetation was tall prairie grasses. About 88 percent of the area of this soil is cultivated, mainly to small grains. Some 7 percent is in pasture; a few small areas are idle.

Ditching to improve surface drainage and plowing under of green-manure crops or applying barnyard manure to improve fertility and aeration are the soil management most needed. Erosion is not a problem.

Lucien stony loam, 3 to 10 percent slopes (LA).—This nonarable shallow stony soil occurs on upland prairie underlain by noncalcareous interbedded soft sandstones and shales.

The soil is brown or dark-brown noncalcareous friable loam containing fragments of the underlying sandstone. The depth over sandstone and sandy shale bedrock is usually from 3 to 10 inches; the color is usually reddish. Locally, the sandstone outcrops as ledges a few feet wide.

The soil is well drained and has gently rolling to rolling slopes. It is so stony that cultivation or mowing of pastures is not feasible except with hand tools. The water-holding capacity is so low that any crop would be likely to suffer from drought. The natural vegetation is mainly bluestem and grama.

This soil lies mainly in the southeast, where it is associated with Chickasha soils. The areas are generally long and narrow, as they follow ridges or escarpments, locally called breaks. Practically all this soil is in native pasture; none is suitable for crops.

Lucien very fine sandy loam, 3 to 5 percent slopes (LB).—This rather shallow, moderately sandy, gently sloping grassland soil is underlain by reddish sandstones. It is associated with Chickasha, Renfrow, and Vernon soils on the upland in the southern part of the county. Although under unusual conditions use of this soil for crops is advisable, it is best used for permanent pasture or meadow.

The surface soil is 6 to 10 inches of reddish-brown, very friable, slightly to medium acid, very fine sandy loam or loam. The red or reddish-brown subsoil is friable but somewhat finer textured than the surface soil. It ranges from a loam to clay loam. The depth of surface soil and subsoil over the underlying substratum of red soft calcareous sandstone and shale varies from 15 to 30 inches. The section on some representative soils and their relationships carries a detailed description of a typical profile.

About 70 percent of the area of this soil is in native pasture or meadow. The natural vegetation is mainly of bluestem grasses; blue and sideoats gramas are prominent in pastures. Some 26 percent of the soil is planted mostly to wheat and oats, and a smaller area is in cotton and sorghums.

Addition of phosphorus greatly increases the yields of field crops and may well prove profitable on native pastures and meadows. All cultivated land not retired to permanent grass needs contour cultivation and careful management to lessen erosion.

Lucien very fine sandy loam, 5 to 10 percent slopes (LC).—This soil is the same as Lucien very fine sandy loam, 3 to 5 percent slopes, except that it is more sloping. The proper use of this soil is permanent pasture or meadow. It is limited to that use by its combination of shallow depth, comparatively low fertility, and slopes that make erosion control on cropped areas difficult and expensive.

About 83 percent of the area is in native pasture or meadow, which produce about the same average yields as meadow on Lucien very fine sandy loam, 3 to 5 percent slopes. Only about 12 percent is cultivated, and on most of this the sod has been broken so recently that erosion has not had time to take effect.

Lucien very fine sandy loam, eroded, 5 to 8 percent slopes (LD).—This soil differs from Lucien very fine sandy loam, 3 to 5 percent slopes, only in being eroded to such degree that the surface soil is now only 2 to 6 inches deep, or about one-fourth to three-fourths of the original thickness.

As indicated on the map this unit includes many small areas, totaling some 1,000 acres, that are severely eroded and have less than 2 inches of the original surface soil.

About 40 percent of this soil is cultivated; the rest was in cultivation but is now in grass or is idle.

Yields are roughly two-thirds of those obtained in the less sloping and less eroded areas mapped as Lucien very fine sandy loam, 3 to 5 percent slopes. Good management requires the return of all of this soil to permanent grass as rapidly as possible.

Miller clay, 0 to 1 percent slopes (MA).—This slowly drained, very fertile, deep, fine-textured alluvial soil occurs in a few places on the flood plain of Black Bear Creek. Reddish-brown granular crumbly clay extends from the surface to a depth of several feet. The soil becomes red instead of reddish brown at depths below 15 to 20 inches. The surface soil ranges from neutral to mildly alkaline; the subsoil is alkaline.

This soil, though very extensive in some other parts of Oklahoma, totals only 800 acres in Noble County. About 68 percent of it is cultivated, mainly to wheat and oats.

Miller silty clay loam, 0 to 1 percent slopes (MB).—This deep, fertile, slowly drained, alluvial soil is similar to Miller clay but has a surface soil of silty clay loam. Though extensive in other parts of Oklahoma, in Noble County this soil totals only a few hundred acres and is confined largely to narrow level stream bottoms. The natural vegetation is flood-plain forest.

The surface soil, a reddish-brown friable silty clay loam, grades into reddish-brown or red clay at depths of 15 to 20 inches. The surface soil and subsoil are neutral to alkaline but generally noncalcareous. In some places the subsoil is stratified with layers of brown or dark-brown clay or clay loam.

Nearly half of this soil is used for pasture because the areas are small and cut by meandering stream channels. Where cultivated, it is very productive of corn, oats, wheat, and alfalfa.

Norge silt loam, 1 to 5 percent slopes (NB).—In many respects this deep moderately fertile permeable soil is similar to Vanoss silt loam, with which it is commonly associated; however, it is somewhat more sloping, more rapidly drained, more susceptible to erosion, and redder, especially in the subsoil.

This gently sloping soil is moderately permeable to roots, air, and water, has good water-holding capacity, and is rapidly drained. It occurs on gently sloping prairies, almost entirely in the northern half of the county. Most of the larger areas are in the northwestern part, between Perry and Billings. Many of the areas are the narrow gently sloping margins of terraces occupied by Vanoss silt loam; and most of them have some gravel in the deeper substrata. A greater total acreage, however, occurs on broad gentle rises, and on many of these the substrata are silty.

The surface soil is brown friable silt loam or loam, generally about 12 inches deep but ranging from 8 to 15. Below this is the reddish-brown friable permeable clay loam upper subsoil. At 25 or 30 inches the upper subsoil generally gives way to firm, blocky, reddish-brown to yellowish-red silty or sandy clay. Friable substrata of yellowish-red or red silts or stratified old alluvium are reached 3½ to 5½ feet below the surface. Except in areas that have been limed, the soil material is medium acid to a depth of about 2 feet. With additional depth the acidity gradually decreases, and the layers below 3 feet are mildly alkaline but generally noncalcareous.

About 62 percent of this soil is in cultivation. Wheat is planted on some three-fifths of this acreage. Oats, corn, sorghums, and cotton are the only other crops planted on as much as 5 percent of the cropland. A few small areas are in alfalfa, which produces well in fields that have received enough lime and phosphorus.

Though somewhat sloping, this soil has excellent physical characteristics. Yields now obtained are considerably below the yields the soil could produce. Use of a crop rotation that includes a legume such as alfalfa or sweetclover, phosphate fertilization, and necessary liming for alfalfa and sweetclover would greatly improve yields of all crops and might double the average yields of corn.

Some erosion has occurred on all of this soil that is in cultivation, but in no field has it reduced the average thickness of surface soil to less than about 8 inches—some three-fourths of the original thickness. The soil, however, is susceptible to erosion, especially in those areas where the slope exceeds 3 percent (pl. 2). Contour cultivation of intertilled crops, stripcropping, and other measures of erosion control should be used in cultivated areas.

Norge silt loam, eroded, 1 to 5 percent slopes (Nc).—This soil covers areas that were originally Norge silt loam, 1 to 5 percent slopes, but have been so much altered by erosion that less than 7 inches of the silt loam surface soil remains. Included are severely eroded spots where the subsoil is exposed or less than 3 inches of silt loam remains. Few or none of these severely eroded areas exceed 3 acres, and in aggregate they total no more than 200 acres, or 10 percent, of the soil.

This soil, though made less useful by erosion, is still suitable for cultivation. It needs improved management to avoid the otherwise inevitable destruction of its value as cropland. All of the soil has been cultivated, mainly to wheat, but some 35 percent has been retired to permanent grass or is now idle. This soil has much the same crop adaptations as Norge silt loam, 1 to 5 percent slopes. The yields are at least one-fourth lower, partly because of the loss of surface soil, a loss that cannot be wholly overcome.

Norge silt loam, 5 to 8 percent slopes (Nd).—This soil is like Norge silt loam, 1 to 5 percent slopes, except it has slightly thinner layers and is so sloping and susceptible to erosion under cultivation that it is hardly suitable for crops. The slope is such that use of this soil for permanent grassland is generally more profitable than use for cropland under adequate protection from erosion. About 62 percent of the area is in native pasture or meadow—its proper use. The areas in crops have been so recently placed in cultivation that little erosion has occurred.

Norge silt loam, eroded, 5 to 8 percent slopes (Ne).—In this unit are parts of Norge silt loam too sloping and eroded for use as cropland. The surface soil averages less than 7 inches thick. At one time or another all of the soil has been cultivated, but approximately one-third is now idle or in permanent grass. About 60 percent is cultivated, but yields probably average less than two-thirds of those produced on Norge silt loam, 1 to 5 percent slopes. This soil should be used for pasture.

Oil-waste land (OA).—Oil-waste land consists of areas destroyed for agricultural purposes by oil, salt water, and other waste from oil wells and drilling operations. Although many areas have minor patches not strongly affected by such wastes, the land as a whole is so affected by oil or salt as to be barren or nearly so. The areas occur in the several oil fields of the county, mainly near Three Sands, Lucien, and south of Billings. The individual areas generally are smaller than 20 acres each.

Owens clay, 5 to 10 percent slopes (OB).—This soil consists of a shallow layer of grayish-brown crumbly clay over gray and yellow calcareous shales. It covers areas of sloping prairie that are productive as permanent grassland but unsuitable for crops. In many respects this soil is like Vernon clay loam, from which it differs mainly in color and in being somewhat more limy, crumbly, and granular.

This soil is rapidly drained sloping prairie; widely scattered small areas are in the northern part of the county. The dominant slope is between 5 and 10 percent, but a few minor areas—less than one-tenth of the total acreage—have gradients of 3 to 6 percent. The principal native grasses are little bluestem, buffalograss, and blue grama.

Areas of native grassland have a surface soil of grayish brown or dark grayish brown strongly granular calcareous clay or heavy clay loam. Below depths of 4 to 8 inches the color lightens and the material grades through a transition of light yellowish-brown or light brownish-gray strongly granular clay. At depths of 10 to 25 inches begins raw, partly weathered, calcareous, grayish and yellowish shales. Most areas that have been cultivated have lost much or all of the darkened surface soil.

Owing to the strongly granular structure, the soil is permeable and absorbs water rapidly when dry; however, it is shallow over nearly impervious substrata. The soil has limited storage capacity for moisture and is comparatively droughty. Few roots penetrate to depths greater than 15 to 25 inches.

About 60 percent of Owens clay is native pasture, the use to which it is best suited. The rest is in crops or idle. Native pasture on this soil affords nutritious grazing at a rate of about 7 acres for a cow through the 9-month grazing period. Supplemental feeding is not needed at this rate of grazing. The minor areas in cultivation are relatively droughty, unproductive, and susceptible to rapid erosion.

Port silt loam, 0 to 1 percent slopes (RA).—This deep, fertile, well-drained, easily worked bottom-land soil is highly productive and well suited to almost every crop that will thrive in Noble County. It occurs extensively in the higher, rarely overflowed, parts of flood plains, especially in those parts along Red Rock and Black Bear Creeks.

The surface soil is reddish-brown or brown (dark brown when moist) friable very granular silt loam or loam. Similar material continues to a depth of about 15 inches, below which the color gradually becomes less dark. Below a depth of about 20 inches the subsoil material is red or reddish-brown friable silt loam. This material is crumbly and permeable and like the surface soil in many respects, but less dark, lower in organic matter, and less granular.

The soil is neutral to mildly alkaline but noncalcareous in the surface soil and either calcareous or noncalareous and mildly alkaline at the lower depths. It is relatively rich in organic matter and of very high inherent fertility.

This soil consists of sediments deposited by floodwaters from the adjacent streams. In most places the sediments are only weakly stratified, and material of texture like that of the surface soil continues to 6 feet or more; however, the extreme range in subsoil texture is from fine sandy loam to clay loam.

Dark layers, which represent former surface soils that have been buried by later sediments, occur in many places and at various depths. In a small proportion of the area, the surface soil is very fine sandy loam or fine sandy loam. The fine sandy loam surface layer covers much in the bottom land along the Arkansas, and commonly there is a subsoil of light fine sandy loam. This inclusion of Port fine sandy loam is decidedly more sandy than this soil, and of lower natural fertility, so that fertilization is needed sooner for maximum yields. This inclusion is very responsive to management and has crop adaptations, management requirements, and value for agriculture similar to Port silt loam, 0 to 1 percent slopes.

The areas of Port silt loam are almost level and free from danger of erosion. In the bottoms of Red Rock and Black Bear Creeks, they constitute large areas of comparatively uniform soil. They are a part of flood plains along the streams that have deeply entrenched channels, or are on second bottoms, or low terraces. All areas are subject to overflow during extreme floods, but these are so rare and of such short duration that crop damage is very uncommon or almost negligible. Floods on this soil are 5 to 50 years apart and seldom last longer than 24 hours.

Although good use of phosphorous and barnyard or green manures will sometimes increase yields enough for a good net profit, very good yields can be obtained without fertilization. Application of agricultural lime is not advisable.

About 85 percent of this soil is cultivated; the rest, in pasture or forest, is inaccessible or in inconveniently shaped small areas isolated from the cropland by property lines or stream channels. Of the cropland, approximately 60 percent is planted to wheat, 15 percent to oats, 10 percent to alfalfa, and 5 percent each to corn, sorghums, and cotton. Yields are considerably below the maximum that could be obtained if the improved crop varieties and management practices now known were applied.

Port silty clay loam, 0 to 1 percent slopes (RB).—This soil is similar to Port silt loam but slightly finer textured, and darker because both the surface soil and subsoil are silty clay loam. Consequently, this soil is slightly stronger but has slightly slower drainage and requires more power for tillage.

The surface soil is a dark-brown or dark reddish-brown friable very granular silty clay loam. It is noncalcareous and neutral or slightly alkaline. Below 10 inches the color gradually lightens with depth

At 15 to 20 inches is a reddish-brown or red friable subsoil material of about the same texture as the surface soil. The subsoil is weakly stratified by either sandier or heavier textured layers. In a few places the subsoil is underlain by silt loam or very fine sandy loam.

The soil is very fertile, permeable, and adequately drained for excellent yields. It has good water-holding capacity and is well suited to all crops common in Noble County. It is located on rarely overflowed flood plains, second bottoms, or low terraces lying mostly along Black Bear and Red Rock Creeks. All areas are subject to overflow during extreme floods, but floods are 5 to 50 years apart and last such a short time that damage to crops is negligible.

Approximately 85 percent of this soil is cultivated, and only about 7 percent is used for pasture. Of the cultivated land, about 70 percent is planted to wheat, 10 percent to oats, 5 percent to alfalfa, and 5 percent to corn.

The soil is productive and probably will remain that way for a long time. Erosion is not a problem, and occasional overflows replenish the supply of nutrients.

Renfrow silt loam, 2 to 4 percent slopes (Rc).—This is a distinctly reddish, moderately fertile and acid soil. It is deeply developed in gently sloping areas of upland prairie underlain by red calcareous shales. It is well suited to crops, especially small grains, but is susceptible to erosion when improperly managed. It is commonly associated with Kirkland and Vernon soils.

The soil has rapid surface drainage and slow permeability to water. The subsoil is a fine textured, slowly pervious, compact clay too droughty for best yields of corn and alfalfa. The subsoil is rarely or never saturated, and careful management is required to prevent injurious erosion of cropland.

Excessive loss of surface soil by erosion is liable to occur whenever the land is bare of vegetation. When winter wheat, barley, or rye are grown, the land is bare for only a short time and erosion is therefore less under these crops than under row crops. If row crops are grown, terracing, planting on the contour, and the use of contour strips help prevent erosion. Contour listing, or the use of damming listers on the contour, also helps to reduce erosion when the land is bare.

Terraces are being used in an effort to reduce erosion. They are of value in diverting water from adjacent higher lands and in breaking the flow on long slopes. Terraces alone, however, will not be effective in controlling erosion. They are more effective when used with contour farming, stripcropping, and crop-residue management.

The surface soil of Renfrow silt loam, 2 to 4 percent slopes, is a dark-brown to reddish-brown friable acid silt loam, 8 to 14 inches deep. The subsoil is reddish-brown compact slowly permeable intractable clay. With additional depth the material becomes redder and changes to neutral or mildly alkaline in reaction. At depths of 3 to 5 feet lie substrata of slightly weathered calcareous or alkaline red clay shale or of shale and subsidiary fine-grained sandstone.

A large part of this soil, especially that in the northeastern part in association with Norge silt loam, has deep reddish silty and clayey substrata that contain some waterworn pebbles. In these areas, unless it has been thinned by erosion, the surface soil is generally slightly thicker (15 to 21 inches) than in areas underlain by red shaly clays. The subsoil in these areas is only moderately compact.

Slick spots—nearly barren small areas of unproductive intractable soil—are mapped by special symbols and are described separately in this report. They are common in many areas of Renfrow silt loam, 2 to 4 percent slopes.

Nearly level areas and eroded areas of this soil are mapped separately as Renfrow silt loam, 1 to 2 percent slopes, and Renfrow silt loam, eroded, 2 to 4 percent slopes.

About 47 percent of this soil is cultivated, and most of the rest is used for pasture and hay. Of the cultivated land, about 65 percent is used for wheat, 10 percent for oats, 15 percent for sorghum, 3 percent for cotton, and 2 percent for other crops. About 5 percent is idle.

The areas that have a thick surface soil over deep reddish silty and clayey subsoil are slightly more productive than the more characteristic areas underlain by very compact, very slowly permeable clay. Summer crops are especially more productive, the yields averaging as much as 10 percent higher.

Management practices that increase yields on Renfrow silt loam, 2 to 4 percent slopes, are (1) use of crop rotations that include a legume such as cowpeas, mung beans, vetch, sweetclover, or alfalfa; (2) applications of phosphorus and barnyard manure either separately or together; and (3) liming if sweetclover or alfalfa is grown. Heavy fertilization is not desirable on this soil, but light applications would improve yields.

Renfrow silt loam, eroded, 2 to 4 percent slopes (RD).—This unit consists of areas of Renfrow silt loam, 2 to 4 percent slopes, that have been so modified by erosion that less than 8 inches of surface soil remains. In about four-fifths of the area the surface soil averages only about 7 inches in thickness. The degree of erosion is moderate.

The natural fertility has been greatly lessened and cannot be wholly restored by any practical means, but much of the land is still suitable for crops. In approximately a fifth of the area, however, the remaining layer of silt loam is less than 4 inches deep. These severely eroded areas are unsuited to crops. All such areas now in crops, extensive enough or adjacent to permanent grasslands, should be put in permanent pasture or meadow.

About 56 percent of this soil is in cultivation. The areas are widely distributed throughout the prairie uplands but are most prevalent in the western and southern parts.

Wheat, oats, and sorghums are the principal cultivated crops. Crop yields vary greatly with variations in depth of surface soil. Yields will generally continue to decline unless steps are taken to check erosion. Improved soil management can double or more than double the yields now obtained under common management.

Farmers are building terraces in an effort to check erosion, and are using contour tillage along with the terraces. Terraces alone are probably of little use in controlling erosion; they should be used with contour tillage, crop rotation, contour stripcropping, and other soil-building practices.

The soil can be brought back to fair productivity by controlling erosion and use of other good management practices, including use of a legume in the crop rotation, and application of phosphorus and any barnyard manure that may be available. The soil is acid and must be limed before either sweetclover or alfalfa will thrive.

For effective erosion control on this soil the following are required: (1) use of the land for intertilled crops no more than one-third of the time; (2) contour cultivation of any intertilled crops; (3) terracing or permanent sodding of places where water concentrates; and (4) retirement of severely eroded areas to permanent grass. Native grasses, such as buffalograss, gramas, and bluestems, are among the most suitable, but some recent introductions, such as African lovegrass, offer much promise. Some fertilization or addition of barnyard manure generally is desirable in establishing a stand on the thinner spots.

Renfrow silt loam, 1 to 2 percent slopes (RE).—This unit is like Renfrow silt loam, 2 to 4 percent slopes, in all respects except for having lesser and more even slopes. Susceptibility to erosion is slight. Much of this soil is the variety of Renfrow developed on mantle rock and having a subsoil of slowly permeable only moderately compact clay. The use, management requirements, crop adaptations, yields, and agricultural capabilities of the soil are much like those of Renfrow silt loam, 2 to 4 percent slopes. Yields average slightly higher.

Renfrow silty clay loam, 2 to 4 percent slopes (RF).—This soil closely resembles Renfrow silt loam, 2 to 4 percent slopes, but differs in having a finer textured and generally somewhat more reddish and thinner surface soil. The surface soil is reddish-brown (dark reddish-brown when moist), friable, moderately granular, acid silty clay loam. It is 8 to 14 inches deep over the subsoil of reddish-brown or red fine-textured clay. The acidity decreases with depth, and the reaction becomes neutral at about 15 inches. The soil is calcareous at 2 to 3 feet. The depth to the underlying substratum of red, calcareous, raw shaly clay is 2½ to 4 feet.

This soil occupies areas of upland prairie, mostly in the northeast. Accelerated erosion ranges from none to slight; 8 inches or more of silty clay loam surface soil remains in all areas. More eroded areas that formerly were this soil are indicated separately as Renfrow silty clay loam, eroded, 2 to 4 percent slopes.

Renfrow silty clay loam, 2 to 4 percent slopes, is moderately fertile, suited to crops, and when correctly managed, safe from erosion and productive of winter small grains. The compact slowly permeable subsoil makes it somewhat too droughty for good yields of such crops as alfalfa and corn. Although the topography is fairly even, much of the rainfall runs off because the subsoil is very slowly permeable. Erosion is moderately rapid on improperly used or managed cropland.

For good management, row crops should be contour stripcropped and erosion-resisting crops should provide a cover for the soil more than half the year (pl. 3, *A*). A few of the fields, possibly 10 percent, have been terraced. Terraces are effective only when used with contour cultivation, but to be successful they must be properly designed, have outlets well protected by permanent grass, and be carefully maintained.

About one-third of this soil is cultivated; most of the rest is in native pasture or meadow. Of the cropland, about 80 percent is used for wheat, 10 percent for oats, and 5 percent for sorghums. Crop rotation and addition of fertilizer are not generally practiced. Use of rotations that include a legume and addition of phosphorus will materially increase crop yields.

Renfrow silty clay loam, eroded, 2 to 4 percent slopes (Rg).—This soil resembles Renfrow silty clay loam, 2 to 4 percent slopes, but erosion has reduced the thickness of the surface soil to less than 8 inches. The depth of the present surface soil varies irregularly from place to place. It is less than 4 inches in only a small proportion, probably less than 5 percent, of the area. It averages about 7 inches throughout the unit. Shallow rills are common where water concentrates on unterraced fields, and there are a few gullies.

Erosion has lowered the natural fertility of this soil and it cannot be wholly restored by practical management (pl. 3, *B*). At the time of survey about 27 percent was in cultivation, mainly to wheat but partly to oats. Average yields vary widely from field to field, but overall, yields are two-thirds to one-half of those produced on Renfrow silty clay loam, 2 to 4 percent slopes. Good management will control erosion on cropped areas of this soil and greatly increase, probably more than double, the yields. Nevertheless, it probably will be more profitable to retire many of the more erodible or eroded areas to permanent grass.

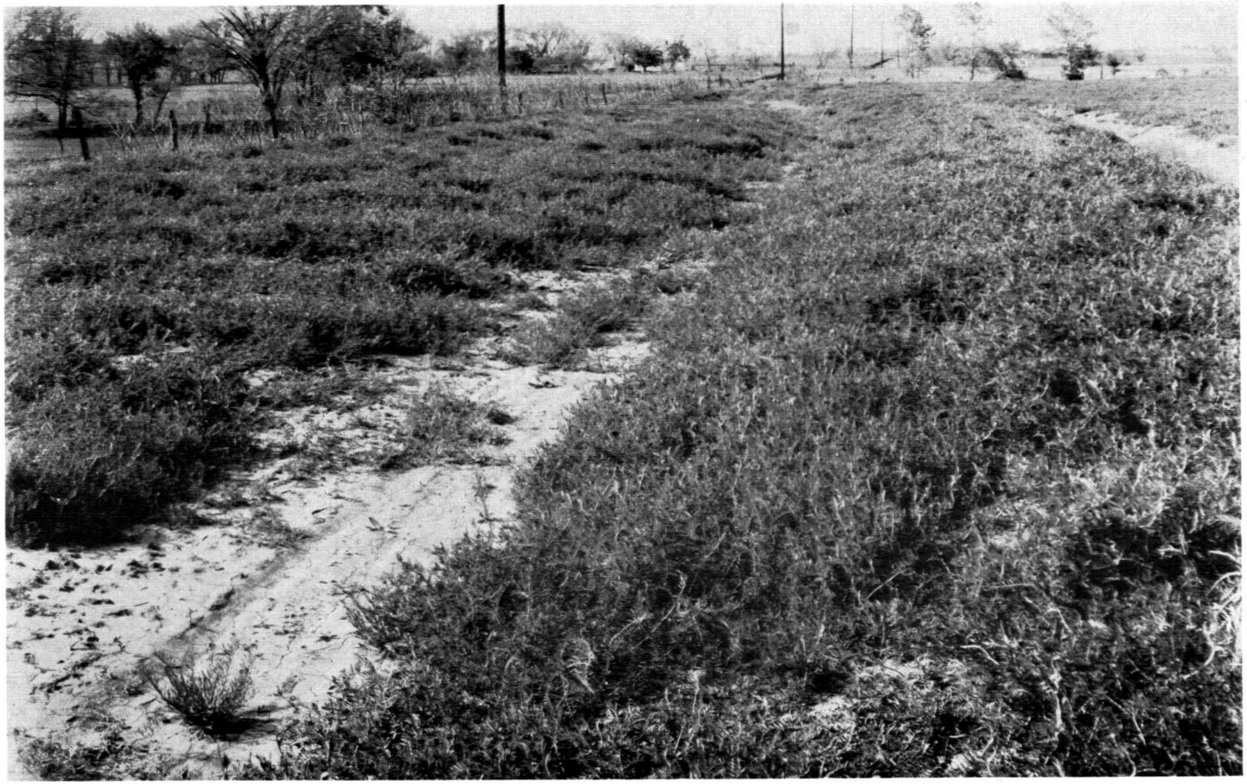
Rough broken land, Norge soil material, 10+ percent slopes (Rh).—This unit is on rough, nonarable, upland prairie underlain by unconsolidated, neutral to calcareous, mostly friable and somewhat reddish loams, silts, and clays. These materials are covered by deposits of old alluvium or eolian material. The topography is rolling to very steep, with slopes of 10 to 100 percent. The unit consists of escarpments, deep gullies, and natural drainageways. It occurs mainly in the northeast, on the dissected margin of high old stream terraces near the Arkansas River. The natural vegetation is largely tall prairie grasses, especially little bluestem, and a few scattered trees. This land is of value only for the sparse grazing and the trees it supports.

Rough broken land, Vernon soil material, 10+ percent slopes (Rk).—This rough nonarable land type is underlain mostly by red, calcareous (or alkaline), nearly impervious shales and clays (red beds). For the most part it is a mixture of strongly sloping areas of Vernon clay loam and raw outcrops of red shaly clays. Some areas in the south, however, have developed on interbedded red shales and fine-grained sandstones, and these are partly of Lucien and partly of Vernon soils. Some other areas located mainly in the northeast have developed on interbedded red and olive-gray calcareous shales, and these are partly of Vernon and partly of Owens soils.

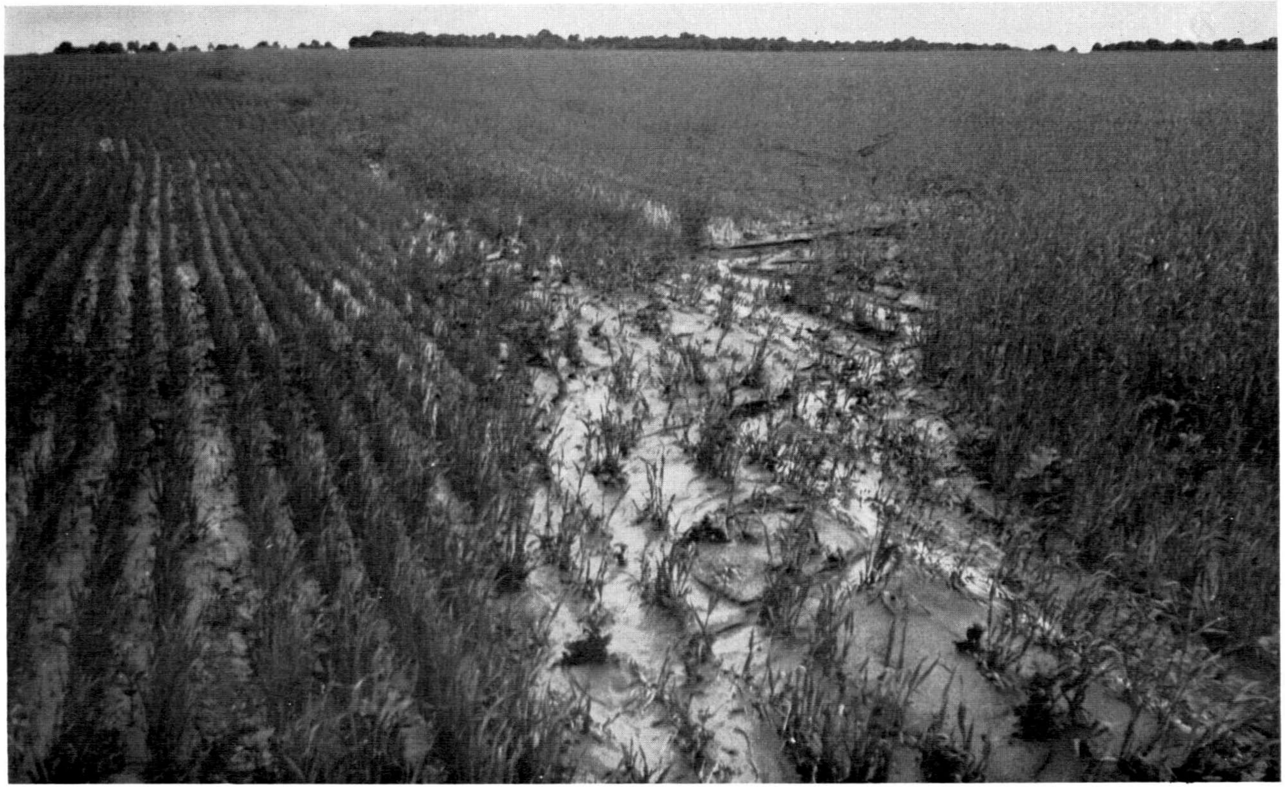
The only use of this land is permanent pasture. It is moderately sloping to steep; the gradients are mostly between 10 and 30 percent but range up to 50. As a whole, the areas have a 25 to 50 percent cover of grasses, mainly little bluestem, gramas, and buffalograss.

Rough stony land, Darnell soil material, 10+ percent slopes (Rl).—This steep to moderately sloping nonarable land is forested

PLATE 1



Hairy vetch protects Canadian fine sandy loam, 0 to 3 percent slopes, from blowing and adds nitrogen and organic matter.



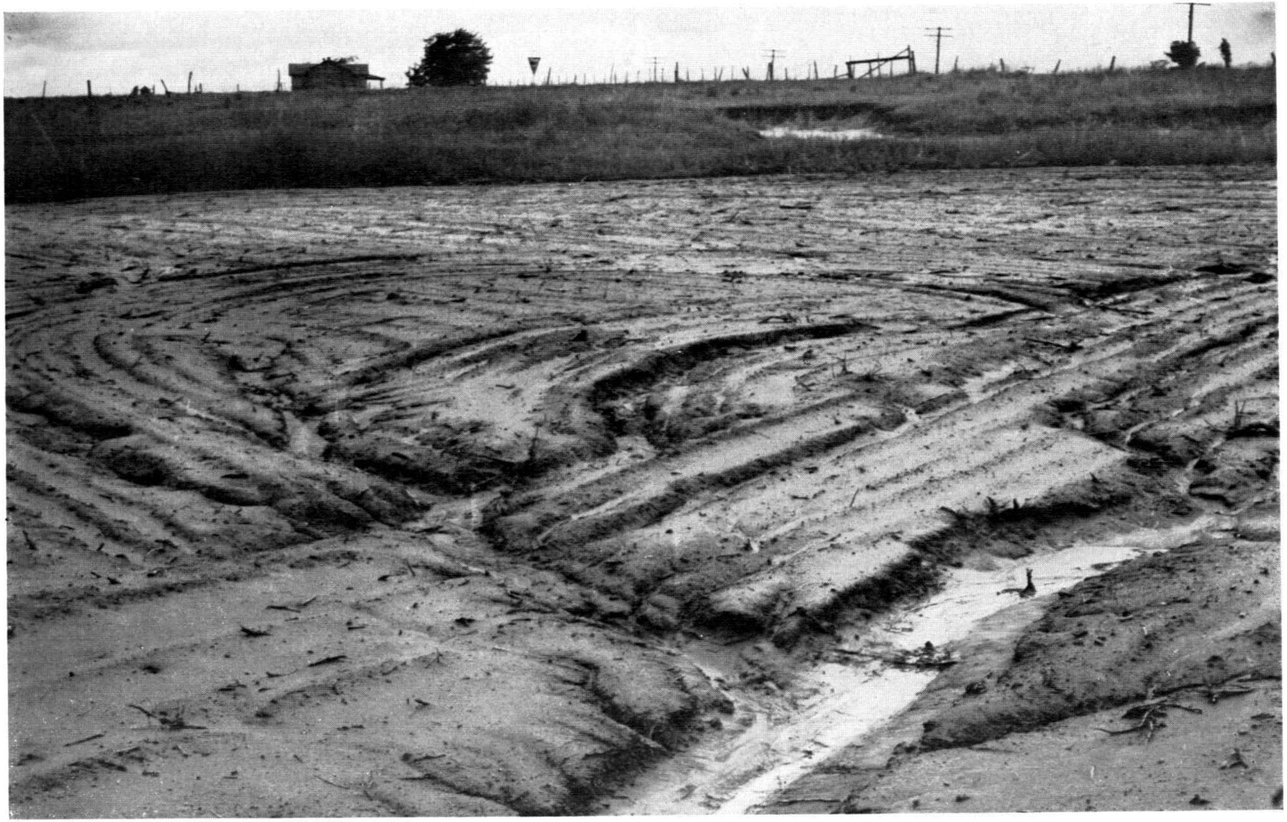
Wheat drilled in straight rows, up and down hill, on Norge silt loam: mismanagement of this kind leads to erosion and poor yields.

A, Good Bermudagrass waterway for disposal of terrace water on Renfrow silty clay loam, 2 to 4 percent slopes.
B, Branched gully, completely healed by Bermudagrass, on Renfrow silty clay loam, eroded, 2 to 4 percent slopes.

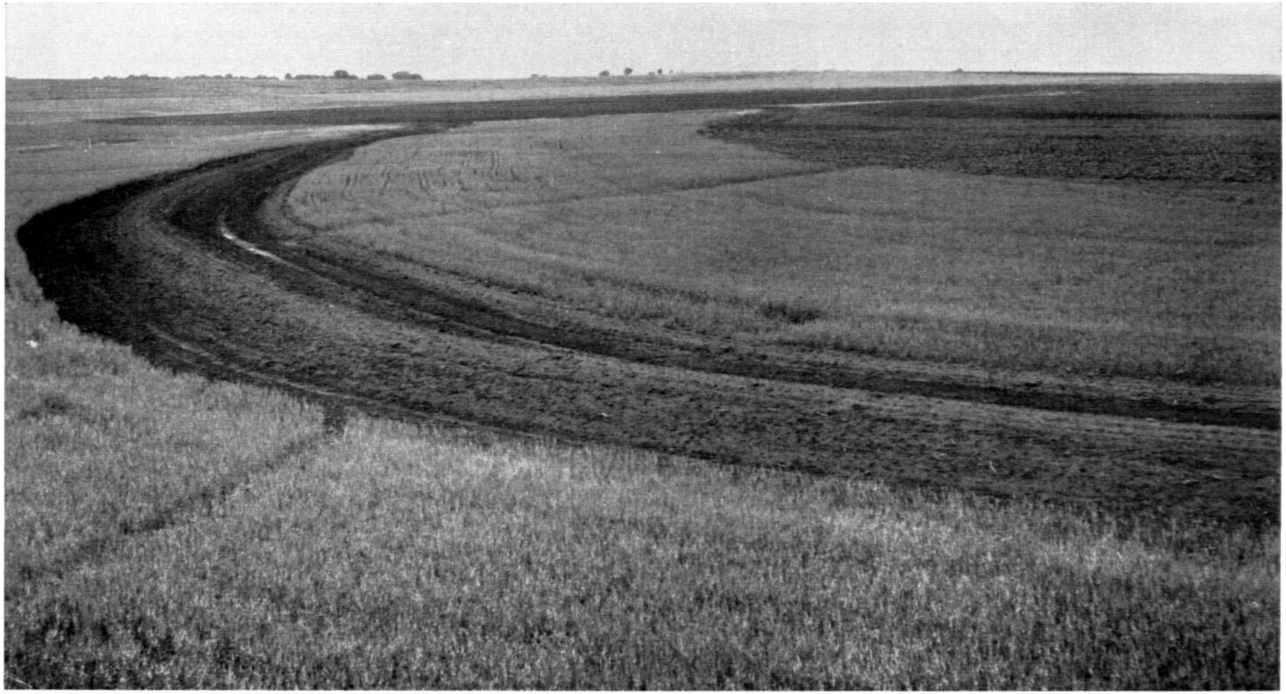
PLATE 4

Madrid sweetclover on Renfrow silt loam. The next year this field yielded 35 bushels an acre, as compared to 17 bushels on the adjoining field where no clover was grown.

PLATE 5

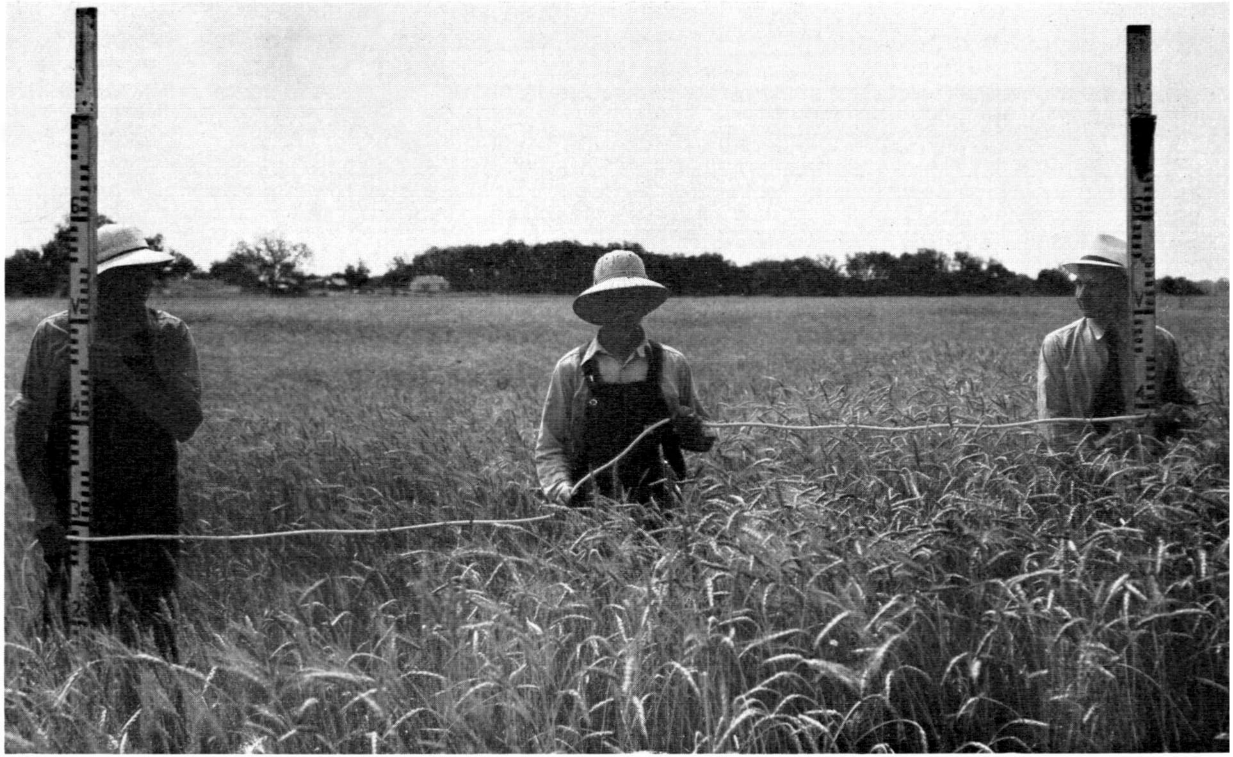


Severe erosion of an unterraced field east of Morrison after a heavy rain.



Terracing, contour farming, and stripcropping on Kirkland silt loam, 2 to 4 percent slopes: alfalfa in foreground, oats in middle distance, and row crop in background.

PLATE 7



Wheat on right followed vetch and that on left followed oats. The wheat on the right made 7 bushels more per acre.

Good grass means good cattle.
A, Excellent range consisting of little bluestem, big bluestem, Indiangrass, and some switchgrass.
B, Jersey cows grazing Sudangrass on Yahola silt loam.

with scrub oak and underlain by somewhat reddish noncalcareous sandstones. The areas are mostly in the central-south part of the county, where they are associated mainly with Stephenville, Darnell, and Chickasha soils.

In most places the soil material is of brown or light reddish-brown acid to neutral very fine sandy loam, less than 10 inches deep over sandstone bedrock. Sandstone outcrops cover 5 to 10 percent of the surface. There are local pockets of medium-deep to deep soils that generally cover less than half an acre. The soil is used as woodland pasture and as a source of firewood. The grazing is scant and of low nutritive value.

Slick spots.—Within areas of many of the soils of the county—most commonly in the Calumet, Kirkland, Tabler and Renfrow soils—there are small barren or nearly barren patches of intractable and infertile soil commonly known as slick spots. These nearly barren spots, generally 10 to 50 feet in diameter, could not be drawn to scale on the map accompanying this report. Instead they are indicated by symbol. In each place where the symbol appears on the map there is one or more slick spots. The maximum area represented by one symbol is one-half acre; however, most of the symbols represent individual slick spots of only about one-fiftieth of an acre.

These nearly barren spots, where uneroded, have a thin surface soil of light-gray crusty loam or silt loam, which is about 5 inches thick and rests abruptly on nearly impervious subsoil of dark-brown or variously mottled gummy intractable clay. Areas that have dried without disturbance after rains have an inch or half an inch of surface crust consisting of puddled, nearly white, silt and very fine sand from which the dark organic matter has disappeared. The upper side of this crust has a distinctive glazed, or slick, appearance, which gives rise to the name, slick spots. The crust is amorphous in its upper half but the lower half is almost entirely filled with roundish air pockets. The subsoil is extremely hard when dry, and when excavated, generally breaks out as clods. The clods are of indeterminate size and shape but tend to be ill-defined columns. The subsoil continues extremely compact and intractable to more than 3 feet. At depths of 4 to 10 feet are more friable or raw substrata of various character; red calcareous shale in the areas associated with Renfrow and Vernon soils, and loamy or clayey old alluvium in areas associated with Calumet soils.

The surface soil and upper subsoil are noncalcareous and mostly medium acid, though locally alkaline. Below depths of 2 to 3 feet the subsoil generally is limy and contains white concretions of impure lime, and frequently some black crystalline pellets or masses, believed to be largely an oxide of iron.

Slick spots are worthless for agriculture and they lower the value of adjoining good soils. They are erosion hazards, places where gullies will start and terraces will break.

Slick spots result from former accumulations of salts, which when removed by rainfall, left the soil impervious and intractable. The use of gypsum (calcium sulfate) with heavy applications of barnyard manure or other organic residues will improve the slick spots considerably, but no generally feasible and wholly satisfactory method of reclamation is known.

The total number of slick spots in the county is approximately 6,000; the aggregate area is approximately 120 acres.

Sogn stony clay loam, 5 to 30 percent slopes (SA).—This stony nonarable grassland soil is very shallow over limestone and is almost entirely in native pasture, its proper and only agricultural use. The areas, mostly narrow bands that follow the outcrops of thin beds of limestone, are largely confined to the northeast. The topography ranges from moderately sloping to steep.

The soil is a dark grayish-brown or dark-brown, friable and granular, calcareous or alkaline clay loam that contains many fragments of partly weathered limestone. It is mostly 4 to 12 inches deep over limestone bedrock. Many areas have a few bare outcrops of limestone.

The vegetation is a thin to moderate cover of grasses, plus trees and shrubs. Buffalograss and the gramas, now dominant, provide nourishing grazing. The original cover was mainly little bluestem.

Summit silty clay loam, 1 to 3 percent slopes (SB).—This deep, crumbly, rather fine-textured soil is one of the darkest on the upland. It has developed under grass in materials weathered from olive or gray limy shales. It has more granular and more permeable subsoil than the Kirkland soils.

The surface soil is dark-gray or dark grayish-brown very granular and crumbly fine-textured silty clay loam of neutral to mildly alkaline reaction. Similar material continues to a depth of 12 to 15 inches, where the color begins to lighten. There is then a grading to gray or grayish-brown fine-textured but somewhat granular and crumbly clay. The depth to the underlying substratum of olive-gray or pale-yellow strongly calcareous raw clay or shale ranges from 3 to 5 feet.

Because of the granular nature of this soil, it is moderately permeable to water, air, and roots despite its fine texture. It has a good content of organic matter and a high water-holding capacity. Crops withstand dry weather fairly well. The soil is on a gently sloping but freely drained upland prairie; slopes range from 1 to 5 percent but are mostly less than 3 percent. The areas are almost all confined to the northern half of the county.

Approximately 50 percent of this soil is cultivated. Wheat occupies about 65 percent of the cropland; oats, about 20 percent; and sorghums, about 10 percent. The soil is fertile, moderately resistant to drought, and has good tilth, but it is susceptible to erosion when improperly managed or misused. Considerable improvement in yields can be obtained by good soil management, such as use of crop rotation, planting of improved crop varieties, and applying phosphorus.

Tabler silt loam, 0 to 1 percent slopes (TB).—This dark, fertile but slowly drained soil is extensive on upland flats in the northwestern quarter. It is quite productive of small grains and well suited to crops, but has a claypan that makes it somewhat too droughty for best yields of corn and alfalfa.

This soil has a high water-holding capacity, but the subsoil is rarely saturated because of its slow permeability. Roots of small grains and native grasses have no difficulty penetrating the subsoil but do not reach so deep as in more permeable soils. The areas are so nearly level that there is no erosion hazard except in some marginal places adjacent to drainageways or slopes. The slope is always less than 1 percent and generally less than 0.5 percent; surface drainage is very slow but generally adequate for common field crops.

The surface soil is a dark grayish-brown, friable and moderately granular silt loam, 11 to 17 inches deep over a claypan subsoil. The claypan subsoil is very compact heavy clay, noncalcareous and nearly black or very dark gray to a depth of about 25 inches, and gray or grayish brown below that depth. The soil is deep to the comparatively raw parent material, which generally is reddish calcareous clay. The organic-matter content is only moderate. Judging from analysis of similar soils in Garfield and Grant Counties, Okla., organic matter is less in the dark claypan than in the lighter colored surface layers. A more detailed description of a representative profile appears in the section, Some Representative Soils and Their Relationships.

The natural vegetation is mainly buffalograss, grama, and bluestem. The buflalograss predominates in pastures. Tabler silt loam is associated with the Kirkland silt loams but occupies more nearly level areas. About 85 percent is in cultivation; most of the rest is native pasture and meadow. About 75 percent of the cropland is used for wheat, 10 percent for oats, and 10 percent for sorghums. The rest is in miscellaneous crops or left fallow.

The soil is suited mainly to wheat, oats, rye, barley, and flax. Except for oats and flax, these crops are fall-sown. Erosion, as a rule, is of minor importance on this soil, so fertility is fairly stable. Methods of retarding runoff are not generally necessary, because water stands on the surface during wet weather.

Neither systematic rotation of crops nor fertilization is generally practiced. Wheat is commonly grown year after year, or interrupted occasionally by a crop of oats. Much improvement in yields can be obtained by excellent management, including use of phosphorus, use of improved crop varieties, and practice of good tillage and planting methods. Except where already limed, the soil is somewhat acid. Liming is advisable for alfalfa or sweetclover.

Tabler silt loam, eroded, 1 to 3 percent slopes (TA).—In this unit are areas of Tabler silt loam so much altered by erosion that the remaining surface soil is less than 11 inches thick. These gently sloping eroded areas are for the most part marginal to small drainageways. The remaining surface soil ranges from 4 to 11 inches in thickness and averages about 8 inches; shallow rills are common where water concentrates.

The moderate erosion of this soil has greatly reduced its natural fertility, but not enough to make the soil unsuited to crops. Often farmers in need of pasture have patches of this soil tied in with better soils. It is, therefore, simpler and more profitable to retire this soil to pasture than to take the necessary steps for erosion control if it is retained as cropland.

About 70 percent of this soil is in cultivation. Most of the cropland is planted to wheat, and a much lesser acreage is in oats. Control of erosion on cropland is generally rather difficult because the areas are normally crossed by runoff drainageways.

Vanoss silt loam, 0 to 1 percent slopes (NA).—This is a deep, moderately dark, relatively fertile, easily worked, well-drained grassland soil of nearly level relief. With proper management it is highly productive and well suited to all the field crops common in the county. Because it has a friable permeable subsoil, it is less droughty and better for corn and alfalfa than the claypan Kirkland and Tabler soils. Vanoss silt loam is one of the most desirable and highly valued soils of Noble County. This soil occurs mainly in high upland flats along Black Bear and Red Rock Creeks; some of the larger areas are about 5 miles west of Perry. The very gently sloping surface (about 0.5 to 1 percent) affords good surface drainage without material danger of erosion of cropland.

Associated soils are mainly the Norge, which is more sloping and redder, and the Kirkland and Tabler, which have claypans and generally are somewhat less sloping.

The Vanoss surface soil is a brown or grayish-brown, granular, friable silt loam, 12 to 20 inches deep and moderately acid except in areas that have been limed. To a depth of 30 inches or more the subsoil is brown, granular, friable, permeable silty clay loam. Below 3 feet in most areas is a layer of brown or reddish-brown compact very slowly permeable clay which becomes redder and less fine textured with depth. This compact but permeable clay grades into reddish friable silty clay loam 5 to 7 feet below the surface. A detailed description of a typical profile appears in the section, Some Representative Soils and Their Relationships.

About 87 percent of the soil is cultivated, mainly to wheat and oats but partly to alfalfa, corn, sorghums, and various minor crops. The original vegetation was tall prairie grasses, mainly bluestems.

Although this soil responds very well to phosphorus, it normally is not applied. Alfalfa and sweetclover produce fair yields when the soil is limed, and very good yields when the soil receives both lime and phosphorus.

Vernon clay loam, 4 to 10 percent slopes (VA).—This is a shallow, reddish, moderately fine textured soil. It occupies rapidly drained sloping upland prairie underlain by clayey red beds. It is associated mainly with Renfrow and Kirkland soils. The vegetation is grasses, mainly buffalograss, grama, and little bluestem. Though physically tillable and of moderate fertility, this soil is poorly suited to crops because of its shallow depth, sloping relief, and susceptibility to erosion.

The surface soil is mostly a clay loam, but ranges to clay or silt loam in local areas. It is reddish-brown, calcareous or alkaline, moderately granular and crumbly clay loam ranging from 4 to 8 inches deep. Below this is a slightly finer textured subsoil of red calcareous or alkaline clay. The depth to the substratum of raw, red clay or shale varies from 10 to 20 inches.

The soil is slowly permeable to water, although air and roots have no difficulty penetrating the upper horizons. The shale substratum is very slowly permeable and, as a rule, is not penetrated by roots. The shallow profile has a low water-holding capacity.

Most of the cultivated areas become eroded after being cropped for two or three seasons. About 27 percent of this soil is cultivated, mostly to wheat and oats. Control of erosion is uneconomical except when this soil is kept in permanent grass, and therefore it is best used as pasture or meadow.

Yahola silt loam, 0 to 1 percent slopes (YA).—This reddish brown soil of the bottom lands is deep, fertile, loamy, and easily worked, and well-drained but occasionally flooded. It occupies well-drained areas on flood plains that are inundated whenever the adjoining stream reaches flood stage, commonly about once a year. It differs from Port silt loam in lying somewhat lower, in being more frequently flooded, and in having less darkening of the soil material to a depth of 15 to 20 inches caused by accumulation of organic matter. The floods subside within a few hours and do not prevent successful crop production. Nevertheless, a very considerable portion of the total area is in very narrow stream bottoms or so close to meandering stream channels that it is poorly suited to cultivation in the extensive type of agriculture that prevails in this county.

Generally, the surface soil is reddish-brown, friable, granular, noncalcareous silt loam or loam. It continues without noticeable change to about 15 inches, where the color is slightly redder and less dark and the granular structure is coarser and weaker. Below this depth is subsoil material of red or reddish-brown mildly alkaline and calcareous silt loam or loam, weakly stratified with layers of slightly sandier and finer textured alluvium. Because it is alluvial, the soil varies somewhat from place to place, especially in degree of sandiness.

The few areas in the flood plain of the Arkansas River are somewhat more sandy and less reddish and represent areas of another but closely related soil, Arkansas fine sandy loam. These areas were included with Yahola silt loam, 0 to 1 percent slopes, because they were so small. These included areas have surface soil of brown, very friable, neutral or mildly alkaline fine sandy loam. The subsoil is light brown or pale brown, moderately sandy, and freely permeable. The productivity, capability for agricultural use, management requirements, and drainage of this included soil are practically the same as those for Yahola silt loam, 0 to 1 percent slopes.

About 39 percent of Yahola silt loam, 0 to 1 percent slopes, is cultivated, about 34 percent is in pasture, and 22 percent is woodland. About 60 percent of the cropland is planted to wheat, 10 percent to oats, 10 percent to corn, 15 percent to sorghums, and 5 percent to alfalfa. The soil is very productive and will probably remain that way for a long time, for floods replenish the supply of plant nutrients.

ESTIMATED YIELDS

Estimated average acre yield of principal crops to be expected on the soils of Noble County are shown in table 4. These are average yields that can be expected over a period of years. In columns A are yields to be expected under the management prevailing in the county at the time of the survey. Under this kind of management, no definite crop rotation is followed, lime and fertilizer are not applied, and soil-conserving measures are not taken. Additional information about prevailing management of the individual soils is given in the section, Soil Descriptions.

In columns B are yields to be expected under improved management. Improved management, as used for these estimates, includes use of definite crop rotations that provide a legume at least 1 year in 4; use of improved crop varieties; application of moderate amounts of phosphorus, and of lime where needed; and use of contour farming, terracing, and stripcropping on the sloping soils. These practices are discussed in the section, Management of Noble County Soils.

TABLE 4.—*Estimated average acre yields of principal crops on soils of Noble County, Okla., under two levels of management*

[Yields in columns A to be expected under prevailing management, which does not include use of crop rotations, addition of lime and fertilizer, or use of soil-conserving practices. Yields in columns B to be expected under improved management, which includes use of crop rotations that contain a legume, application of lime and fertilizer, use of improved crop varieties, and use of soil-conserving practices; blank spaces indicate crop is not grown under present conditions (columns A) or is not recommended (columns B)]

Soil	Map symbol	Wheat		Oats		Corn		Cotton lint		Sorghum for grain		Sorghum for fodder		Alfalfa		Pasture
		A	B	A	B	A	B	A	B	A	B	A	B	A	B	A
		Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Lbs.*	*Lbs.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Cow-acre-days*[1]
Albion loam, 2 to 5 percent slopes	Aa	7	15	12	20	----	----	----	----	7	12	1.0	1.5	----	----	40
Albion loam, eroded, 5 to 8 percent slopes	Ab	4	----	8	----	----	----	----	----	4	----	0.7	----	----	----	20
Broken land, Reinach soil material, 20+ percent slopes	Ba	----	----	----	----	----	----	----	----	----	----	----	----	----	----	30
Calumet silty clay loam, 0 to 1 percent slopes	Cb	9	20	30	40	10	----	140	220	14	20	1.2	2.0	1.2	1.5	45
Calumet-Drummond silt loams, 0 to 1 percent slopes	Ca	9	18	30	35	10	----	150	210	14	20	1.2	2.0	1.2	1.5	40
Canadian fine sandy loam, 0 to 3 percent slopes	Cd	14	18	28	32	26	45	165	205	20	32	2.0	3.0	2.0	2.2	55
Canadian fine sandy loam, 3 to 5 percent slopes	Cc	10	18	20	28	20	40	165	200	14	28	1.5	2.0	----	----	55
Chickasha loam, 3 to 5 percent slopes	Ce	10	18	20	35	13	30	150	190	16	23	1.2	2.0	1.0	2.0	50
Chickasha loam, eroded, 3 to 5 percent slopes	Cf	7	15	16	26	10	----	100	150	9	18	1.2	2.0	----	----	40
Chickasha loam, 0 to 3 percent slopes	Cg	11	18	22	37	15	30	165	200	18	25	1.2	2.0	1.0	2.0	50
Chickasha loam, 5 to 10 percent slopes	Ch	8	----	16	----	9	----	100	----	9	----	1.2	----	----	----	50
Chickasha loam, eroded, 5 to 10 percent slopes	Ck	6	----	11	----	10	----	60	----	5	----	.7	----	----	----	40
Dale silt loam, 0 to 1 percent slopes	Da	15	20	34	55	25	45	200	310	26	40	2.5	3.5	2.0	3.0	60

Darnell-Stephenville fine sandy loams, 3 to 10 percent slopes	Db	6	----	10	----	8	----	80	----	6	----	.5	----	----	----	10
Derby loamy fine sand, 3 to 7 percent slopes	Dc	----	----	----	----	----	----	----	----	----	----	----	----	----	----	15
Gowen silt loam, 0 to 1 percent slopes	Ga	14	20	32	50	20	45	200	290	26	42	2.0	3.5	2.0	3.0	60
Gowen silty clay loam, 0 to 1 percent slopes	Gb	14	20	34	50	20	45	200	290	26	42	2.0	3.5	2.5	3.5	60
Kay silty clay loam, 0 to 1 percent slopes	Kb	16	20	40	60	24	40	200	280	22	30	2.5	3.0	2.5	3.0	65
Kirkland silt loam, 0 to 2 percent slopes	Ke	12	20	20	31	8	----	150	240	12	20	1.2	2.0	1.5	2.0	55
Kirkland silt loam, 2 to 4 percent slopes	Kc	10	20	18	28	8	----	125	200	9	16	1	1.7	----	----	50
Kirkland silt loam, eroded, 2 to 4 percent slopes	Kd	6	12	14	20	----	----	----	----	----	----	1	1.6	----	----	15
Lela clay, 0 to 1 percent slopes	Ka	12	20	30	50	----	----	125	200	8	16	1.7	1.5	1.0	1.5	35
Lucien stony loam, 3 to 10 percent slopes	La	----	----	----	----	----	----	----	----	----	----	----	----	----	----	30
Lucien very fine sandy loam, 3 to 5 percent slopes	Lb	9	----	16	22	8	----	100	----	9	16	1	1.5	----	----	35
Lucien very fine sandy loam, 5 to 10 percent slopes	Lc	7	----	14	----	----	----	100	----	7	----	.7	----	----	----	45
Lucien very fine sandy loam, eroded, 5 to 8 percent slopes	Ld	6	----	12	----	----	----	75	----	6	----	.5	----	----	----	25
Miller clay, 0 to 1 percent slopes	Ma	9	20	20	32	10	40	200	270	12	22	1.2	2.0	1.0	1.2	60
Miller silty clay loam, 0 to 1 percent slopes	Mb	11	20	24	34	13	45	200	270	16	24	1.7	2.5	1.5	2.0	65
Norge silt loam, 1 to 5 percent slopes	Nb	15	20	32	47	22	30	150	250	18	28	1.7	2.5	1.7	2.0	65
Norge silt loam, eroded, 1 to 5 percent slopes	Nc	9	15	20	32	15	----	125	200	10	18	1	2.0	----	----	40
Norge silt loam, 5 to 8 percent slopes	Nd	12	18	25	35	18	----	150	----	13	----	1.2	2.0	----	----	60
Norge silt loam, eroded, 5 to 8 percent slopes	Ne	9	15	20	30	15	----	100	----	10	----	1	1.5	----	----	40
Oil-waste land	Oa	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Owens clay, 5 to 10 percent slopes	Ob	5	----	14	----	----	----	60	----	6	----	1.5	----	----	----	40
Port silt loam, 0 to 1 percent slopes	Ra	16	25	34	50	24	50	200	300	22	40	2	2.5	2.2	4.0	60
Port silty clay loam, 0 to 1 percent slopes	Rb	14	20	35	50	24	45	200	300	20	40	2	2.5	2.0	2.5	60
Renfrow silt loam, 2 to 4 percent slopes	Rc	10	20	24	34	10	----	125	200	13	20	1	1.7	----	----	50

See footnote at end of table.

TABLE 4.—*Estimated average acre yields of principal crops on soils of Noble County, Okla., under two levels of management*—Continued

Soil	Map symbol	Wheat		Oats		Corn		Cotton lint		Sorghum for grain		Sorghum for fodder		Alfalfa		Pasture
		A	B	A	B	A	B	A	B	A	B	A	B	A	B	A
		Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Lbs.*	*Lbs.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Cow-acre-days*
Renfrow silt loam, eroded, 2 to 4 percent slopes	Rd	6	8	14	20	----	----	75	----	6	----	.5	----	----	----	30
Renfrow silt loam, 1 to 2 percent slopes	Re	11	25	25	35	12	----	150	200	14	22	1	1.7	----	----	55
Renfrow silty clay loam, 2 to 4 percent slopes	Rf	11	20	26	32	12	----	125	200	13	20	1	1.7	----	----	50
Renfrow silty clay loam, eroded, 2 to 4 percent slopes	Rg	6	8	14	20	----	----	75	----	6	----	.5	----	----	----	30
Rough broken land, Norge soil material, 10+percent slopes	Rh	----	----	----	----	----	----	----	----	----	----	----	----	----	----	15
Rough broken land, Vernon soil material, 10+percent slopes	Rk	----	----	----	----	----	----	----	----	----	----	----	----	----	----	25
Rough stony land, Darnell soil material, 10+percent slopes	Rl	----	----	----	----	----	----	----	----	----	----	----	----	----	----	10
Sogn stony clay loam, 5 to 30 percent slopes	Sa	----	----	----	----	----	----	----	----	----	----	----	----	----	----	35
Summit silty clay loam, 1 to 3 percent slopes	Sb	13	20	27	40	14	16	165	245	14	22	1.2	2.0	1.5	1.7	70
Tabler silt loam, 0 to 1 percent slopes	Tb	11	20	25	35	10	12	150	240	12	20	1.0	1.7	1	1.5	50
Tabler silt loam, eroded, 1 to 3 percent slopes	Ta	5	6	12	18	----	----	75	----	6	----	.7	----	----	----	20
Vanoss silt loam, 0 to 1 percent slopes	Na	15	20	35	37	24	30	165	265	20	30	2.0	2.8	1.7	2.5	55
Vernon clay loam, 4 to 10 percent slopes	Va	7	----	20	----	----	----	75	----	11	----	.7	----	----	----	40
Yahola silt loam, 0 to 1 percent slopes	Ya	14	20	28	45	20	45	200	340	22	38	2.0	2.4	2	2	40

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[1] Cow-acre-days is the number of days in a year that 1 acre will graze a mature cow, steer, or horse without injury to the pasture.

Comparison of yields in columns A with those in columns B will show what kind of response the various soils will make under improved management. More information about management of the soils can be obtained from the Oklahoma Agricultural Experiment Station. The local Soil Conservation Service representative or the county agricultural agent will assist you in working out a farm plan that will control erosion, improve tilth, and increase crop yields.

MANAGEMENT OF NOBLE COUNTY SOILS

By Horace J. Harper, Oklahoma Agricultural Experiment Station

Management of the cultivated land in Noble County must take into account the fact that the natural fertility of the soils has been the principal source of plant nutrients for growing crops during the past 50 years.

In some cultivated fields, continuous growing of wheat and other soil-depleting crops has reduced the supply of organic matter in the soils, and erosion has removed much, or all, of the surface soil from the steeper slopes. Erosion and declining fertility are problems that need to be met by improved management.

The loss of fertility also can be judged by comparing cultivated soils with those not cultivated. Table 5 compares the average amount of organic matter, total nitrogen, total phosphorus, available phosphorus, and average pH of 34 samples each of cultivated and adjacent virgin soils. The table shows that the cultivated samples have lost 39.8 percent of their original organic matter, 38.6 percent of their nitrogen, and 19.2 percent of their phosphorus. On the average, the cultivated samples are no more acid than the virgin soils.

Recent rapid increase in use of fertilizer is evidence of the fact that farmers in the county are aware of the decline in soil fertility. The following tabulation shows how the amount of fertilizer used has increased since 1946.

Year	*Tons*	*Year*	*Tons*
1946	280	1950	2, 652
1947	410	1951	2, 658
1948	650	1952	3, 535
1949	1, 127	1953	3, 113

Before 1946, use of fertilizer was negligible. The range was from none at all to 20 tons annually.

TABLE 5.—*Loss of organic matter, nitrogen, and phosphorus resulting from cultivation for 34 soils in Noble County, Okla.*

Soil condition	pH	Organic matter	Nitrogen	Phosphorus	Easily soluble phosphorus
		Pounds [1]	*Pounds*	*Pounds*	*Pounds*
Virgin	6. 5	75, 200	3, 200	520	84
Cultivated	6. 4	45, 400	2, 000	420	76
Loss		29, 800	1, 200	100	8

[1] Pounds per acre of soil to a depth of 6⅔ inches.

The average quantity of easily soluble phosphorus shown in table 5 is much higher than the average for cultivated and virgin soils of the uplands in this county. Samples of virgin and cultivated soils of the bottom lands were included in this study. The bottom-land samples contained very large quantities of easily soluble phosphorus. Their inclusion in the study raises the average and tends to obscure the fact that many of the upland soils in the county are low in available phosphorus.

Chemical analyses (see table 6) verify that many of the soils of the uplands in this county are very low in both total and easily soluble phosphorus. The amount of phosphorus in the various soils cannot be judged from their texture. Four profiles collected from typical areas of the Renfrow series verify this. Two of the Renfrow profiles sampled (Nos. 47 and 29) are low in total and easily soluble phosphorus, and the other two (Nos. 20 and 9) are much higher in both. The difference between the two low in phosphorus and the two high in phosphorus cannot be correlated with texture.

TABLE 6.—*Chemical composition of soils of Noble County, Okla.*

SOILS OF UPLANDS

Soil type, sample No., and location	Depth	pH	Organic matter	Total nitrogen	Total phosphorus	Readily available phosphorus
Albion loam, 2 to 5 percent slopes (Sec. 26, T. 22 N., R. 1 E.) (43):	*Inches*		*Percent*	*Percent*	*Percent*	*Parts per million*
7486	0– 10	6. 6	2. 40	0. 09	0. 014	4
7487	10– 26	6. 6	1. 20	. 05	. 010	2
7488	26– 48	6. 7	. 50	. 03	. 006	1
7489	46– 66+	7. 2	. 40	. 01	. 005	2
Chickasha loam, 3 to 5 percent slopes (Sec. 32, T. 21 N., R. 2 E.) (40):						
7439	0– 4	6. 3	5. 50	. 19	. 022	14
7440	4– 10	5. 7	3. 00	. 14	. 018	4
7441	10– 16	5. 7	2. 50	. 09	. 018	2
7442	16– 26	5. 8	1. 60	. 05	. 016	2
7443	26– 32	6. 1	. 90	. 04	. 011	1
7444	32– 50	6. 1	. 40	. 03	. 008	2
Chickasha loam, 3 to 5 percent slopes (Sec. 12, T. 20 N., R. 1 E.) (16):						
7513	0– 7	6. 4	3. 90	. 14	. 017	8
7514	7– 16	6. 2	2. 50	. 11	. 016	4
7515	16– 24	6. 1	1. 60	. 07	. 011	1
7516	24– 30	6. 3	. 80	. 06	. 007	1
Darnell-Stephensville fine sandy loams, 3 to 10 percent slopes (Sec. 15, T. 21 N., R. 3 E.) (21):						
7561	0– 2	6. 8	5. 10	. 18	. 021	18
7562	2– 6	6. 8	1. 75	. 08	. 014	4
7563	6– 18	6. 4	1. 05	. 06	. 011	2
7564	18– 24	5. 8	1. 05	. 06	. 014	2

TABLE 6.—*Chemical composition of soils of Noble County, Okla.*—Continued

SOILS OF UPLANDS—Continued

Soil type, sample No., and location	Depth	pH	Organic matter	Total nitrogen	Total phosphorus	Readily available phosphorus
Derby loamy fine sand, 3 to 7 percent slopes (Sec. 21, T. 24 N., R. 3 E.) (50):	*Inches*		*Percent*	*Percent*	*Percent*	*Parts per million*
7593	0– 2	7. 1	3. 30	. 13	. 029	200+
7594	2– 12	7. 3	. 72	. 03	. 019	130
7595	12– 70+	7. 6	. 21	. 01	. 012	40
Kirkland silt loam, 0 to 2 percent slopes:						
Sec. 33, T. 24 N., R. 1 E. (47A):						
7505	0– 3	6. 8	5. 27	. 18	. 022	18
7506	3– 7	6. 6	3. 20	. 12	. 019	10
7507	7– 14	5. 0	2. 50	. 11	. 014	4
7508	14– 30	6. 7	1. 90	. 07	. 012	6
7509	30– 42	8. 0	. 70	. 03	. 008	4
7510	42– 80+	7. 7	. 40	. 02	. 007	14
Sec. 8, T. 20 N., R. 2 W. (15):						
7596	0– 1½	6. 8	6. 40	. 21	. 024	34
7597	1½– 6	5. 7	4. 05	. 16	. 021	12
7598	6– 13	6. 5	3. 05	. 13	. 018	8
7599	13– 17	6. 6	2. 34	. 09	. 016	2
7600	17– 28	7. 1	1. 48	. 08	. 013	2
7601	28– 38	8. 0	. 39	. 02	. 007	4
7602	38– 65	7. 1	. 91	. 04	. 009	14
Sec. 23, T. 24 N., R. 2 W. (15a):						
7786	0– 2	5. 7	5. 50	. 17	. 024	28
7787	2– 12	5. 9	2. 90	. 13	. 020	8
7788	12– 16	6. 7	2. 10	. 09	. 016	4
7789	16– 34	7. 6	1. 20	. 06	. 013	8
7790	34– 60	6. 1	. 60	. 03	. 010	6
Lucien very fine sandy loam, 3 to 5 percent slopes (Sec. 13, T. 21 N., R. 1 E.) (17):						
7480	0– 7	6. 4	2. 80	. 20	. 013	12
7481	7– 16	6. 2	1. 80	. 08	. 011	8
7482	16– 26	6. 3	. 80	. 04	. 007	4
7483	26+	6. 1	. 30	. 03	. 005	2
Norge silt loam, 1 to 5 percent slopes:						
Sec. 6, T. 24 N., R. 4 E. (57):						
7460	0– 7	5. 8	3. 40	. 16	. 026	18
7461	7– 12	5. 7	2. 90	. 13	. 023	12
7462	12– 18	5. 7	2. 20	. 10	. 019	4
7463	18– 36	6. 0	. 90	. 04	. 011	2
7464	36– 84	6. 5	. 50	. 03	. 015	90

TABLE 6.—*Chemical composition of soils of Noble County, Okla.*—Continued

SOILS OF UPLANDS—Continued

Soil type, sample No., and location	Depth	pH	Organic matter	Total nitrogen	Total phosphorus	Readily available phosphorus
Norge silt loam, 1 to 5 percent slopes—Con.						
Sec. 9, T. 23 N., R. 1 E. (56):	*Inches*		*Percent*	*Percent*	*Percent*	*Parts per million*
7519	0– 5	6. 7	4. 70	. 19	. 022	10
7520	5– 12	6. 7	3. 50	. 15	. 020	8
7521	12– 26	6. 6	2. 00	. 10	. 014	2
7522	26– 54	6. 9	. 70	. 04	. 008	2
7523	54–100	8. 1	. 20	. 02	. 006	4
Norge silt loam, 5 to 8 percent slopes (Sec. 28, T. 22 N., R. 1 E.) (57BB):						
7535	0– 7	6. 6	3. 83	. 13	. 017	12
7536	7– 16	6. 4	2. 44	. 09	. 012	4
7537	16– 30	6. 5	. 84	. 04	. 009	4
7538	30– 46	6. 7	. 36	. 02	. 007	14
7539	46– 96+	7. 5	. 16	. 01	. 007	30
Owens clay, 5 to 10 percent slopes (Sec. 28, T. 23 N., R. 1 W.) (61):						
7573	0– 5	7. 6	3. 05	. 15	. 044	80
7574	5– 12	7. 9	1. 20	. 07	. 038	6
7575	12– 28	8. 2	. 68	. 04	. 036	3
7576	28– 52	6. 9	. 83	. 03	. 045	4
7577	52+	8. 1	. 26	. 04	. 014	4
Renfrow silt loam, 2 to 4 percent slopes:						
Sec. 36, T. 24 N., R. 2 E. (47):						
7425	0– 7	5. 9	4. 10	. 17	. 022	12
7426	7– 12	5. 8	2. 60	. 11	. 017	4
7427	12– 24	6. 6	1. 67	. 08	. 013	4
7428	24– 38	7. 9	. 79	. 08	. 010	4
7429	38– 60	7. 8	. 36	. 02	. 019	30
Sec. 20, T. 21 N., R. 2 W. (9):						
7648	0– 5	6. 1	2. 90	. 12	. 045	88
7649	5– 9	6. 2	1. 68	. 07	. 039	112
7650	9– 13	6. 6	1. 60	. 08	. 031	72
7651	13– 24	7. 4	1. 21	. 07	. 015	8
7652	24– 48	5. 2	. 21	. 03	. 012	14
Renfrow silty clay loam:						
Sec. 21, T. 21 N., R. 1 W. (29):						
7447	0– 2	6. 2	6. 80	. 27	. 031	24
7448	2– 8	6. 1	4. 00	. 16	. 026	18
7449	8– 14	6. 4	2. 60	. 13	. 021	12
7450	14– 20	6. 7	2. 10	. 10	. 019	14
7451	20– 40	8. 1	1. 00	. 06	. 021	22

TABLE 6.—*Chemical composition of soils of Noble County, Okla.*—Continued

SOILS OF UPLANDS—Continued

Soil type, sample No., and location	Depth	pH	Organic matter	Total nitrogen	Total phosphorus	Readily available phosphorus
Renfrow silt clay loam—Continued						
Sec. 34, T. 22 N., R 2 E. (20):	*Inches*		*Percent*	*Percent*	*Percent*	*Parts per million*
7475	0– 2	7. 5	6. 20	. 23	. 036	100
7476	2– 10	7. 6	5. 40	. 23	. 034	170
7477	10– 50	8. 4	1. 10	. 07	. 030	190
Rough broken land, Vernon soil material, (11):						
7496	0– 6	7. 6	2. 70	. 26	. 024	30
7497	6– 18	7. 8	. 70	. 05	. 034	40
7498	18+	7. 9	. 60	. 03	. 027	110
Sogn stony clay loam, 5 to 30 percent slopes (Sec. 19, T. 24 N., R. 3 E.) (2):						
7565	0– 6	7. 4	4. 55	. 22	. 049	50
7566	6– 12+	7. 5	2. 62	. 13	. 037	2
Summit silty clay loam, 1 to 3 percent slopes (Sec. 34, T. 23 N., R. 1 W.) (60):						
7551	0– 2	6. 6	7. 20	. 30	. 040	100
7552	2– 14	6. 8	4. 25	. 17	. 031	36
7553	14– 18	6. 9	2. 85	. 11	. 026	34
7554	18– 24	7. 1	2. 40	. 10	. 025	38
7555	24– 32	7. 6	1. 53	. 06	. 019	28
7556	32– 66	7. 6	. 88	. 04	. 015	8
Tabler silt loam, 0 to 1 percent slopes:						
Sec. 31, T. 24 N., R. 3 E. (38):						
7410	0– 8	6. 1	3. 10	. 15	. 023	18
7411	8– 12	6. 5	2. 13	. 10	. 019	12
7412	12– 26	6. 8	2. 13	. 12	. 022	20
7413	26– 40	8. 3	. 63	. 05	. 020	70
7414	40– 70	8. 4	. 38	. 03	. 017	70
Sec. 33, T. 23 N., R. 2 W. (14):						
7574–A	0– 3	6. 9	5. 60	. 21	. 026	34
7575–A	3– 8	6. 9	2. 20	. 09	. 018	8
7576–A	8– 13	7. 2	1. 72	. 10	. 016	4
7577–A	13– 25	7. 1	1. 95	. 10	. 026	26
7578	25– 30	7. 5	1. 31	. 06	. 019	38
7579	30– 42	7. 1	. 80	. 04	. 022	140
7580	42– 60	7. 6	. 51	. 03	. 026	120
7581	60– 88	7. 5	. 19	. 02	. 013	36

TABLE 6.—*Chemical composition of soils of Noble County, Okla.*—Continued

SOILS OF THE TERRACES AND BOTTOM LANDS

Soil type, sample No., and location	Depth	pH	Organic matter	Total nitrogen	Total phosphorus	Readily available phosphorus
Calumet-Drummond silt loams (70):	*Inches*		*Percent*	*Percent*	*Percent*	*Parts per million*
7614	0– 6	6.0	4.45	.17	.027	37
7615	6– 12	6.6	2.30	.09	.018	14
7616	12– 32	7.1	1.65	.08	.014	18
7617	32– 58	8.0	.84	.04	.016	56
7618	58– 72	8.7	.44	.03	.026	152
7619	72–100+	8.4	.21	.02	.017	112
Calumet silty clay loam, 0 to 1 percent slopes (Sec. 7, T. 23 N., R. 1 W.) (71):						
7627	0– 6	6.7	2.58	.12	.043	88
7628	6– 14	7.0	1.70	.08	.023	44
7629	14– 20	7.3	1.45	.06	.018	44
7630	20– 40	7.2	1.63	.07	.022	40
Canadian fine sandy loam (53):						
7499	0– 4	6.7	4.00	.14	.027	80
7500	4– 10	7.1	1.20	.04	.017	90
7501	10– 40	7.0	.30	.01	.011	24
7502	40– 90+	6.9	.30	.02	.011	24
Sec. 13, T. 24 N., R. 3 E (53):						
7748	0– 4	5.3	3.17	.11	.022	36
7749	4– 9	6.7	1.31	.06	.018	32
7750	9– 32	6.4	.45	.03	.011	22
7751	32– 70+	6.8	.31	.03	.012	30
Dale silt loam (64):						
7752	0– 2	5.8	4.20	.18	.030	38
7753	2– 10	6.0	2.78	.13	.026	14
7754	10– 26	6.4	2.48	.10	.020	12
7755	26– 30	6.9	1.49	.06	.012	8
7756	30– 48	7.5	.76	.03	.013	26
7757	48– 96	6.5	.46	.02	.014	64
Gowen silty clay loam, 1 0 to 1 percent slopes:						
Sec. 12, T. 23 N., R. 1 E. (25):						
7417	0– 6	7.1	3.61	.17	.040	150
7418	6– 18	6.7	3.21	.14	.045	150
7419	18– 66	7.0	.69	.05	.024	100
7420	66–100	7.1	.59	.02	.019	90
Sec. 24, T. 20 N., R. 2 W. (73):						
7526	0– 2	6.7	6.75	.26	.029	40
7527	2– 8	7.5	4.10	.19	.023	36
7528	8– 14	7.6	1.71	.08	.019	34
7529	14– 46+	7.8	.89	.05	.020	40

TABLE 6.—*Chemical composition of soils of Noble County, Okla.*—Continued

SOILS OF THE TERRACES AND BOTTOM LANDS—Continued

Soil type, sample No., and location	Depth	pH	Organic matter	Total nitrogen	Total phosphorus	Readily available phosphorus
Gowen silt loam, 0 to 1 percent slopes (Sec. 14, T. 24 N., R. 2 W.) (63):	*Inches*		*Percent*	*Percent*	*Percent*	*Parts per million*
7778	0– 3	6. 1	3. 70	. 14	. 027	64
7779	3– 8	5. 9	2. 90	. 13	. 027	48
7780	8– 12	6. 6	2. 50	. 11	. 022	40
7781	12– 48	7. 2	1. 10	. 05	. 014	36
7782	48– 60	7. 4	. 70	. 05	. 017	44
7783	60– 72	6. 2	. 35	. 02	. 025	96
Kay silty clay loam, 0 to 1 percent slopes (Sec. 11, T. 23 N., R. 1 E.) (35):						
7766	0– 2	6. 4	5. 20	. 17	. 033	80
7766–A	2– 10	6. 6	2. 60	. 11	. 027	40
7767	10– 18	7. 3	2. 00	. 08	. 018	22
7768	18– 32	7. 4	2. 20	. 08	. 021	28
7769	32– 62	8. 1	1. 10	. 05	. 036	96
7770	62–100	6. 3	. 52	. 03	. 031	104
Lela clay, 0 to 1 percent slopes (Sec. 6, T. 24 N., R. 1 E.) (72):						
7432	0– 2	6. 6	7. 20	. 31	. 055	100
7433	2– 16	6. 7	3. 20	. 16	. 041	45
7434	16– 30	7. 2	1. 85	. 09	. 033	80
7435	30– 50	7. 9	1. 40	. 07	. 032	100
7436	50– 84	7. 9	. 70	. 02	. 035	170
Miller clay, 0 to 1 percent slopes (Sec. 7, T. 21 N., R. 3 E.) (24):						
7542	0– 2	7. 6	8. 80	. 32	. 057	200
7543	2– 10	7. 5	4. 35	. 19	. 054	200+
7544	10– 20	7. 3	1. 78	. 08	. 039	180
7545	20– 42	7. 0	. 85	. 05	. 026	140
7546	42– 70	6. 9	. 45	. 02	. 016	130
7547	70– 90+	6. 9	1. 80	. 06	. 031	190
7548	90+	7. 0	. 57	. 01	. 020	34
Port silty clay loam, 0 to 1 percent slopes (Sec. 28, T. 22 N., R. 1 E.) (7):						
7622	0– 6	6. 2	2. 42	. 13	. 034	136
7623	6– 16	6. 7	2. 08	. 10	. 027	40
7624	16– 28	7. 1	1. 83	. 08	. 019	36
7625	24– 46	7. 4	. 67	. 03	. 015	36
7626	46– 74	8. 3	. 98	. 04	. 018	56

TABLE 6.—*Chemical composition of soils of Noble County, Okla.*—Continued

SOILS OF THE TERRACES AND BOTTOM LANDS—Continued

Soil type, sample No., and location	Depth	pH	Organic matter	Total nitrogen	Total phosphorus	Readily available phosphorus
Port silt loam:						
Sec. 29, T. 22 N., R. 1 W. (8):	*Inches*		*Percent*	*Percent*	*Percent*	*Parts per million*
7582	0– 4	7.1	4.70	.21	.042	180
7583	4– 9	7.0	2.14	.09	.030	100
7584	9– 28	6.9	.75	.04	.018	70
7585	28– 36	6.4	1.95	.07	.024	38
7586	36– 72	6.4	2.10	.08	.021	34
7587	72–144	7.3	.26	.02	.022	90
Sec. 8, T. 24 N., R. 4 E. (8):						
7603	0– 10	7.8	1.04	.03	.127	136
7604	10– 24	7.8	.99	.03	.030	144
7605	24– 30	8.3	.29	.01	.021	120
Vanoss silt loam, 0 to 1 percent slopes:						
Sec. 21, T. 24 N., R. 3 E. (37):						
7454	0– 10	6.6	4.00	.17	.039	75
7455	10– 26	6.0	2.30	.13	.035	36
7456	26– 60	6.2	1.30	.08	.034	70
7457	60– 90	7.7	.60	.04	.027	120
Sec. 28, T. 22 N., R. 2 E. (45):						
7467	0– 7	6.2	3.10	.14	.019	8
7468	7– 18	6.0	2.10	.11	.016	4
7469	18– 30	5.8	1.50	.07	.015	2
7470	30– 42	6.0	1.30	.08	.014	2
7471	42– 66	6.2	.60	.04	.009	2
7472	66– 90	6.6	.40	.03	.006	4
Yahola silt loam, 0 to 1 percent slopes:						
Sec. 28, T. 22 N., R. 1 W. (3):						
7567	0– 6	7.2	2.42	.11	.026	120
7568	6– 34	7.5	1.22	.06	.021	70
7569	34– 56	7.6	.57	.04	.019	100
7570	56– 80	7.8	.20	.02	.013	90
Sec. 21, T. 24 N., R. 3 E. (Arkansas River) (3):						
7590	0– 14	7.1	.99	.05	.030	200+
7591	14– 30	7.2	1.43	.07	.035	200+
7592	30+	7.6	.47	.02	.019	180+

As shown in table 6, most of the upland soils have a greater amount of easily soluble phosphorus in the surface soil than in the subsurface layers, and this difference may continue to depths of 20 inches or more. For example, the chemical analyses indicate that two Renfrow profiles (Nos. 20 and 9) were derived from sediments higher in total and available phosphorus than the sediments from which the other two (Nos. 47 and 29) developed.

An accumulation of loess may account for the larger quantity of total and easily soluble phosphorus in the surface part of two of the Renfrow samples. Wide variation in phosphorus content also occurred in the two Vanoss samples (Nos. 37 and 45). One sample was much lower in total and available phosphorus than the other, which indicates a difference in origin of the sediment from which the two profiles developed. Chemical data should be used more extensively as a guide to mapping and correlation of soils in some areas.

Soils of the local stream terrace and bottom lands usually have a chemical composition similar to that of the alluvium from which they originated. Nevertheless, the amount of easily soluble phosphorus in both surface and subsurface layers is normally much higher in these soils than in upland soils.

The problem of phosphorus deficiency.—Chemical tests show that a deficiency in readily soluble phosphorus is the most important limitation on yields of cool-season crops on most of the cultivated land in this county. Chemical tests on 330 soil samples collected in this area before 1941 reveal that more than 52 percent of the soils are low to very low in easily soluble inorganic phosphorus. Study of 1,197 samples of soil analyzed in the office of the county agricultural agent during the period 1950–53 shows that 78.5 percent of the soils tested low to very low in easily soluble inorganic phosphorus.

Cooperative experiments have been conducted with several farmers in Noble County to determine how phosphorus, applied alone and in combination with nitrogen, affects wheat yields. The results from three soil types are listed as follows:

	Yield in bushels
Albion loam (Harry Edwards Farm, Perry, Okla. 1949):	
No fertilizer	9.3
15 pounds superphosphate per acre	23.5
30 pounds superphosphate per acre	27.3
20 pounds superphosphate and 20 pounds ammonium nitrate per acre	25.5
Tabler silt loam (Henry Billman Farm, Red Rock, Okla., 1953):	
No fertilizer	19.3
40 pounds superphosphate per acre	24.8
40 pounds superphosphate and 40 pounds ammonium nitrate per acre	25.6
Vanoss silt loam (J. B. Brigham Farm, Red Rock, Okla., 1950):	
No fertilizer	14.5
22.5 pounds superphosphate per acre	21.7
22.5 pounds superphosphate and 16.5 pounds ammonium nitrate per acre	27.3

The three soils listed in the foregoing tabulation are representative of the upland soils in this county. If phosphorus fertilizer is added, the cool-season crops produce better yields because they are able to use more of the nitrogen that is available in the soil. During the past 50 years, much of the nitrogen released through decay of organic matter in the soil has been wasted because the soils did not contain enough available phosphorus to enable plants to use the nitrogen.

The response of warm-season crops to phosphate fertilizer is different. When the soils are moist and warm, micro-organisms liberate some of the phosphorus in the soil organic matter. The amount thus liberated may be enough to supply much of phosphorus required for growth of such crops as Sudangrass and sorghums. These crops, planted on soils high in organic matter, but low in available inorganic phosphorus, do not show a profitable response to superphosphate. On these same soils, however, addition of superphosphate will bring a profitable increase in the yield of cool-season crops such as small grains, hairy vetch, sweetclover, and alfalfa. This results because phosphate is not readily released from the soil organic matter during cool weather.

Nitrogen and organic matter.—In supply of organic matter, the Albion, Tabler, and Vanoss soils are fairly representative of the soils in the county. The Albion and Tabler contain about 2 percent of organic matter, and the Vanoss a higher percentage. Most of the soils of the county contain more than 2 percent organic matter, and only a few contain less than 1.5 percent.

A soil that contains 2 percent of organic matter supplies more nitrogen than a wheat crop normally can use under the climate that prevails in this area. If a medium-textured soil has less than 1.5 percent organic matter, a profitable increase in yield of wheat can be obtained by growing sweetclover, hairy vetch, alfalfa, or a similar soil-building legume in the rotation (pl. 4). The dark-colored clay soils also give better yields if legumes are used in the crop rotation, but they do this because the legumes improve the structure of the soil, not because the clay soils are short of available nitrogen.

Weather affects the response of soils to nitrogen. If enough rain falls late in September or early in October, a soil high in organic matter may yield more wheat if ammonium sulfate or ammonium nitrate is applied. This happens because the nitrates released by decay of organic material during the summer have been leached downward into the deeper subsoil out of reach of roots of crops such as wheat.

The samples of Kirkland silt loams (Nos, 47A, 15, and 15a) given in table 6 shows the effect of soil organic matter on the supply of total phosphorus. These profiles have more total phosphorus in the surface layer than in the subsoil because the surface layers contain a lot of organic matter, which holds organic phosphorus. The total phosphorus in a soil profile usually declines with depth because there is less organic matter as depth increases.

Lime.—Cultivated gently sloping soils that are not being injured by erosion will gradually become more acid as lime is lost through leaching and removal by crops. A sandy soil with a permeable subsoil becomes acid more rapidly than a medium or fine textured soil with a slowly permeable subsoil.

Study of pH values given in tables 5 and 6 will show that the soil profiles in Noble County are not highly leached. The pH values of many of the soils that have developed on fine-textured sediments increases from the surface downward. This increase indicates that the subsoils have been able to retain the calcium dissolved and removed from the surface soils through weathering and subsequent leaching.

The soils of the county contain lime, but many of them do not have enough for good growth of legumes. Table 7 shows how the yield of sweetclover is affected by limestone applied alone or in combination with manure or phosphate. Sweetclover yields increase when barnyard manure, superphosphate, or rock phosphate is applied alone.

The increase is much greater, however, when one of these amendments is applied after limestone has been mixed with the soil to neutralize acidity. Furthermore, yields of barley following sweetclover on land that received both phosphate and lime were much higher than on land that received only phosphate.

TABLE 7.—*Effect of lime and phosphate on the production of biennial white sweetclover* [1]

Plot number	Type of fertilizer applied	Fertilizer	Dry hay from the second year of sweetclover
		Pounds per acre	*Pounds per acre*
1	None	None	1, 230
2	Manure	12, 000	2, 280
3	Limestone	6, 000	2, 940
4	20-percent superphosphate	200	3, 690
5	20-percent superphosphate	400	3, 330
6	Rock phosphate	200	3, 900
7	Rock phosphate	1, 000	3, 000
8	Manure Limestone	12, 000 6, 000	4, 530
9	Superphosphate Limestone	200 6, 000	3, 910
10	Superphosphate Limestone	400 6, 000	4, 710
11	Rock phosphate Limestone	200 6, 000	4, 050
12	Rock phosphate Limestone	1, 000 6, 000	3, 840

[1] Experiment on C. J. Wallerstedt farm, Perry, Okla. See, Oklahoma Agricultural Experiment Station Bulletin 206, p. 13.

Plot experiments conducted for a 25-year period on soil similar to much of that occurring on gently sloping uplands in Noble County show that the soils in Noble County probably need a ton of lime an acre every 12 to 15 years to maintain a reaction favorable for growth of sweetclover. Of course, heavier applications than this will be needed to correct the initial acidity. Lime will have to be applied more often on sandy soils that have a permeable subsoil. A soil test is the best way to determine when lime is needed to improve the growth of lime-loving crops.

A total of 369 samples of surface soil collected from different parts of Noble County before 1941 were analyzed in the soils laboratory at Stillwater, Okla. The analyses showed that 78 samples were strongly acid, 103 were moderately acid, 70 were slightly acid, 50 were neutral, and 68 were basic in reaction. During the period 1950–53, the county agent in Noble County tested 1,199 samples, of which 54 percent were moderately to strongly acid; about 30 percent, slightly acid; and the rest, neutral or basic in reaction. These soil tests reveal that more than two-thirds of the cultivated land in this county needs limestone if it is to produce optimum yields of sweetclover and alfalfa.

Experiments show that an application of agricultural limestone will not increase the yield of fall-planted wheat on a strongly acid soil that has a high organic-matter content. On such a soil, in seasons when the weather is wet and cold, lime may increase the yield of spring-planted oats; this happens because soil bacteria break down organic matter more rapidly in a neutral soil than in an acid soil.

Erosion.—If erodible soils are used for cultivated crops, efforts to improve them are often wasted unless a combination of engineering practices and cropping methods are used that will protect the soils. In this county a considerable acreage of moderately to steeply sloping land not protected by vegetation has been severely sheet and gully eroded (pl. 5). Also, in large gently sloping fields, runoff may concentrate to such extent that areas not protected by vegetation will be damaged.

A limited acreage of steeply sloping land used for cultivated crops should be planted to native grasses that would control erosion. Nevertheless, many eroded soils that do not contain too much clay will produce profitable yields of wheat, provided the crop is grown in a short rotation that includes sweetclover and the soil receives tillage and mechanical treatment that prevents further damage from runoff.

Wheat, the principal crop in this county, is fairly effective in controlling erosion because it covers the ground a large part of the year. The numerous areas of eroded wheatland in the county, however, are evidence that wheat alone cannot be relied upon to control erosion. Rotation of wheat and other small grains with legumes, proper fertilization, correct tillage methods, plus terracing or other engineering methods, where needed, will give effective control of erosion (pl. 6). The management that increases and maintains crop yields is the management that does most to control erosion. Terracing or other engineering devices used alone are not effective.

Ask your local Soil Conservation Service representative for advice on control of erosion. He can help you work out a complete erosion control plan for your farm.

Crop rotation.—Rotation of legumes with wheat and other small grains is effective for increasing yields and checking erosion (pl. 7). Few farmers in the county practice crop rotation, though almost all the soils will produce a fair crop of some type of legume. Experimental results indicate that yields of small grains can be increased 30 to 50 percent on many of the soils merely by growing them in rotation with a legume and adding lime. Many of the soils are too acid for good growth of legumes; lime must be added to such soils before legumes will grow a stand that will protect the soils and provide the organic matter and nitrogen that will increase soil productivity.

Alfalfa is the best legume to use to increase the amount of available nitrogen and active organic matter in many upland soils and in those bottom-land soils not frequently overflowed or poorly drained. On large acreages, biennial sweetclover can be used more effectively than alfalfa. The sweetclover is planted in a crop of barley or spring oats and provides grazing or seed the second year.

Tillage methods.—When the moldboard plow is used, plowpans develop in some medium-textured soils used for wheat and other crops. A plowpan is a layer of slight clay accumulation or cementation just under the furrow slice. It retards downward movement of water and plant roots. Legumes should be rotated with wheat and other small grains to help break up this plowpan. If a tap-rooted legume such as sweetclover or alfalfa is planted on soils that have a plowpan at a depth of 7 to 10 inches, the roots usually penetrate the plowpan in enough places to permit satisfactory movement of water, air, and plant roots into the subsoil.

Chisels also can be used to destroy a plowpan. In fact, they may be necessary to improve some soils that have a dense plowpan. Some chisels attach to the shank of a moldboard plow and loosen the soil in the bottom of the furrow. Others are used with tool-bar equipment, and with this kind, the chiseling is a separate operation. The soil can be first given a shallow tillage with a one-way disk plow and then gone over with chisels set 12 inches deep and 12 inches apart laterally. This is more effective and requires less power than if the chisels are set to penetrate deeper and are spaced farther apart.

Tillage changes the physical appearance of a soil if the surface layers are less than 4 or 5 inches thick and disguises the loss of organic matter that occurs during cropping. The change is greater in soils that were originally forested than in soils once covered with grass. Loss of organic matter from medium and fine textured soils is normally associated with a deterioration of soil structure and a decline in the ability of the soils to hold moisture. Very often cultivated soils have more organic matter below the plow layer than in that layer itself. This is the result of continued plowing and the growing of soil-depleting crops.

Tractor-farming has speeded up the process of soil depletion by stirring and mixing the surface layers to greater depths. This kind of farming need not be harmful. It will not be if the physical structure of the soils is preserved by adding organic matter. Then, when the native fertility of the soil will no longer produce crops satisfactorily, plant nutrients can be added in commercial fertilizers.

Studies have been made on small grains at the Perkins Farm of the Oklahoma Agricultural Experiment Station. The grains were planted on a medium-textured soil. A 5-year rotation consisting of spring oats, sweetclover, and winter wheat was used. Subsurface tillage was practiced to keep the crop residue on the surface where it would protect the soil from runoff coming from adjacent land where all the crop residue was turned under every year by a moldboard plow.

The first year of the rotation, spring oats were drilled in 14-inch rows and later sweetclover was planted between the rows; the second year, the land was left in sweetclover; and for three years following, the land was planted to winter wheat.

With the 5-year rotation and a subsurface tillage to prepare the seedbed for the first planting, wheat averaged 21.8 bushels an acre for an 11-year period.

Weed control was not a problem on the land used for the 5-year rotation. Preparation of the land for spring oats broke the growth cycle of winter weeds and grasses. In some areas where winter wheat has been planted every year, without subsurface tillage or other means of control, winter weeds and grasses have been a problem.

These studies show that correct tillage practices, combined with a well-chosen crop rotation, will increase yields, reduce weed infestation, and at the same time, protect the soil from erosion.

Pasture management.—Virgin prairie of tall grasses originally covered most of the pastureland. Much of this pastureland occurs in the eastern third of the county. The topography is more rolling there, and many shallow soils occur on moderately to steeply sloping land. The surface layer of some of this pastureland has more clay than much of cultivated land. The principal problem in pasture management is to increase the use of grazing practices that will maintain or improve the growth of native grasses. Perennial weeds, where abundant, can be controlled by spraying with 2,4-D or other effective weedkillers. A few wooded areas of pastureland occur in the southeastern part of the county and along some stream channels. On these the growth of native or introduced grasses would greatly improve if the trees and brush were killed by cutting or spraying.

SOME REPRESENTATIVE SOILS AND THEIR RELATIONSHIPS

By Edward H. Templin, United States Department of Agriculture

The soils of Noble County are chiefly members of the Reddish Prairie great soils group, or geographical associates of those soils. Most of them have developed under grass in residuum derived from red calcareous clays and shales.

The climate is temperate, continental, and subhumid. The average annual temperature is 60° F.; and the average annual precipitation, 34.5 inches. Thornthwaite's PE index is 58, which is within the range called subhumid in his classification of climate.[2]

The vegetation of the area at the time of settlement was tall prairie grasses. Exceptions were the flood plains and some small areas of sloping upland in the central-southern part of the county that are underlain by sandstone. These sandstone areas of the upland were covered with a grassy scrub forest of blackjack oak and post oak.

Permian rocks exposed in Noble County have been designated by Clark and Cooper[3] as members of the Stillwater, Wellington, and Garber formations. These dip to the west, and outcrop in north-south belts from east to west in the order listed. Permian rocks account for all the surface formations older than Quaternary.

The Stillwater, Wellington, and Garber formations have been built up from continental sediments that are relatively high in the minerals that weather and release bases fairly rapidly. They contain somewhat differing proportions of clayey red beds, sandy shales, and sandstones, and also of quartz. The variations in these parent materials are reflected in the soils that have formed from them.

Chemical analyses made by the Agronomy Department of the Oklahoma Agricultural and Mechanical College indicate that, as a general rule, the soils developed from these formations are moderately low in phosphorus. They are nearly always materially lower in phosphorus than soils developed just west of Noble County in the overlying Hennessey shale and Duncan sandstone.

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[2] BLUMENSTOCK, DAVID I., and THORNTHWAITE, C. W. CLIMATE AND THE WORLD PATTERN. *In* Climate and Man, U. S. Dept. Agr. Yearbook, 1941, pp. 98–127.

[3] CLARK, G. C., and COOPER, C. L. KAY, GRANT, GARFIELD AND NOBLE COUNTIES. *In* Oil and Gas in Oklahoma. Okla. Geol. Survey Bul. 40: 67–194, illus., 1930.

Stillwater formation.—This is the basal formation of the Permian in central and northern Oklahoma. Only the upper half of it outcrops in Noble County. Here it consists of red or red and gray, fine-grained, neutral to alkaline but noncalcareous, soft sandstones and sandy shales. Noble County is near the northern limit of the reddish, mostly sandy, terrestial facies that comprise the formation. The sandstones and sandy shales decrease northward and interfinger with clayey red beds that contain several thin limestones, mainly the Fort Riley, Winfield and Herrington beds. The clayey red beds, in turn, continue only a short distance north of Noble County before merging into the gray and olive shales or mudstones interbedded with limestones that comprise the Marion and Chase formations of Kansas. This merging occurs at the so-called color line, which separates red terrestial facies to the south from non-red marine facies to the north.

Wellington formation.—The outcrop of this formation is 51 to 20 miles wide. It makes up the central three-fourths of the county along United States Highway No. 64; it extends westward from a point a mile west of Bills Corner to 2 miles east of Lucien. The formation consists of red calcareous or alkaline clays and shales. South of Black Bear Creek this formation interfingers with and grades into noncalcareous reddish sandy shales and soft sandstones of the Lucien formation.

Garber formation.—In this county only the basal part of the Garber formation, or the Lucien sandstone, is exposed. The formation consists of clayey red beds interbedded with red, noncalcareous, fine-grained sandstone.

SOILS OF THE CLAYEY RED BEDS

The important soil series of this county that developed in residuum weathered from the clayey red beds are the Tabler, Kirkland, Renfrow, and Vernon. These four series form a catena, which is a group of soils developed from similar parent material but different in characteristics because of differences in relief or drainage. Internal drainage is not important in the catenary relation of these four series because the very slowly pervious shale substrata make such drainage almost nonexistent. Increasing slope and attendant increase in surface drainage therefore are the source of differences among the series. The Tabler soils have slopes of less than 0.5 percent; the Kirkland, from 0.5 to 3 percent; the Renfrow, from 2 to 5 percent; and the Vernon, more than 5 percent.

Differences among profiles.—The main easily observed difference among Tabler, Kirkland, and Renfrow profiles is in color. The Tabler has a dark-gray to gray A horizon, with lighter gray films coating the aggregates in the basal 2 to 4 inches, and a very dark-gray B_2 horizon. The Kirkland has a grayish-brown to brown A_1, either with or without lighter gray films toward its base, and a brown to dark-brown B_2 horizon. The Renfrow has a brown to reddish-brown A horizon, with no suggestion of gray films toward its base, and a reddish-brown B_2 horizon.

The Vernon series as developed in this county is not representative of the Vernon series as a whole. This happens because the county is near the extreme eastern and most humid limit of the geographic range for the Vernon series. In this county the Vernon soils have an A horizon that is commonly noncalcareous and very slightly darker than the same horizon in drier areas more representative of the series. Representative profiles for Tabler, Kirkland, and Vernon soils follow.

Tabler silt loam (200 ft. NW. of SW. corner sec. 33, T. 23 N., R. 2 W.):

This Tabler soil is on a high upland flat between Red Rock and Black Bear Creeks. The flat is in the central undissected part of an alluvial plain, probably of middle late Pleistocene age; it lies 75 feet above the creek flood plain and has slopes of 0 to 0.5 percent. The native pasture is largely blue grama and buffalograss. Before disturbance the vegetation probably was little and big bluestems.

Surface water does not stand. The soil stays wet no longer than 2 or 3 days after rain during the warm seasons and is too dry for plant growth several weeks or months nearly every summer. During cool seasons, the soil is generally moist, and occasionally wet, but the water table is never closer to the surface than 15 feet, and drainage is favorable for field crops.

Profile description:

A_1 0 to 10 inches, dark-gray (10YR 4/1 dry; 10YR 3/1, moist) silt loam; friable; moderate medium granular; medium acid.

A_2 10 to 12 inches, similar to A_1 horizon except exteriors of aggregates are gray; interiors are dark gray as in the A_1 horizon.

A_3 12 to 14 inches, transitional layer of dark-gray, friable, strongly granular silty clay loam; granules coated with lighter gray films.

B_2 14 to 30 inches, very dark-gray (10YR 3.5/1; 10YR 2/1, moist) heavy clay; very firm and compact when moist, very hard when dry; compound prismatic and fine blocky; blocks irregular, coated with varnishlike films, dark-gray to dark grayish-brown inside; horizon contains a few scattered shotlike ferruginous pellets or fine concretions; plant roots abound throughout horizon but are somewhat concentrated in crevices between aggregates; medium acid in upper part but becomes neutral in lower.

B_3 30 to 50 inches, dark-gray (10YR 4/1.5; 10YR 3/2, moist) clay slightly mottled with specks and streaks of brown; very compact and very slowly permeable when moist; noncalcareous though mildly alkaline; contains scattered hard fine concretions of $CaCO_3$, which have solution-pitted surfaces and appear to be degrading; layer also contains some small, soft, ferruginous concretions.

C_1 50 to 70 inches, brown (7.5YR 4/2) noncalcareous or weakly calcareous, mildly alkaline, compact clay mottled or streaked with grayish brown and reddish brown; contains very dark brown ferruginous concretions and films.

C_2 70 to 80 inches +, yellowish-red, slightly calcareous, only moderately firm sandy clay; probably this is a mantle of Pleistocene alluvium, some 10 to 30 feet thick, over bedrock of red Permian shales.

Kirkland silt loam (1,500 ft. N. of SW. corner sec. 14, T. 21 N., R. 3 E.):

This Kirkland soil had a slope of 1.5 percent and was in native pasture consisting mostly of buffalograss and grama. The original cover probably was tall grasses.

Profile description:

A_1 0 to 12 inches, grayish-brown (10YR 4/2; 10YR 2.5/2, moist) silt loam; weakly granular; friable; pH 5.5; passes to B_2 horizon through a transition less than one-half inch thick.

B_2 12 to 25 inches, brown (10YR 4/3; 10YR 3/3, moist) clay; very firm and compact when moist, extremely hard when dry, strong prismatic; prisms crumble to fine irregular blocks that have varnished and glistening surfaces; abundant plant roots are somewhat concentrated in crevices between aggregates but also are numerous within aggregates; layer contains a few scattered black shotlike ferruginous concretions; pH 6.0 at 20 inches; grades to B_3 horizon.

B_3 25 to 42 inches, yellowish-brown (10YR 5/4; 10YR 4/4, moist) clay; very firm and compact when moist, extremely hard when dry; coarse blocky; very slowly permeable; fine earth is noncalcareous though mildly alkaline but horizon contains scattered fine hard concretions of $CaCO_3$; concretions have solution-pitted surfaces and appear to be degrading; layer also contains a few small ferruginous concretions; grades indistinctly to C_1 horizon.

C_1 42 to 64 inches, reddish-brown (5YR 5/4; 5YR 4/4, moist) clay; very firm but somewhat less so than B_2 and B_3 horizons; mildly alkaline though noncalcareous; contains a few very fine concretions of $CaCO_3$, fewer and smaller than those in the B_3 horizon; grades to C_2 horizon.

C_2 64 to 76 inches, red (2.5YR 4/6) firm calcareous clay containing soft concretions of $CaCO_3$; grades into the underlying rock.

C_3 76 to 90 inches +, red (2.5YR 4/6) calcareous raw clay containing thin seams of red, soft, fine-grained sandstone (Stillwater formation of Permian age).

Vernon clay loam (SW¼SW¼SW¼ sec. 13, T. 21 N., R. 2 E.):

This Vernon soil was in native pasture and had slopes of 5 to 8 percent. It had a moderate cover of buffalograss and grama; probably the original cover was mainly little bluestem. The soil is on an outcrop of the Stillwater formation.

Profile description:

A_1 0 to 12 inches, dark-red (10YR 3/3) clay loam; moderate coarse granular; firm; neutral above becoming mildly alkaline below; grades into C horizon.

C 12 to 25 inches +, parent material of dark-red partly weathered weakly calcareous shaly clay containing a few seams of red sandy shale; contains a few concretions of $CaCO_3$ between depths of 12 and 18 inches, but none below.

The profile of Tabler soil described in this section has developed in old alluvium rather than in residuum. Strictly speaking, it belongs to a different catena than the Kirkland, Renfrow, and Vernon. The Tabler soils are so strongly developed, however, that virtually identical soils have been formed from considerably different parent materials. Furthermore, in mapping soils, it is practically impossible to make accurate separations based on the character of substrata that are at depths of 6 to 10 feet. The Tabler series is therefore defined so as to include soil developed both in residuum from clayey red beds and soil developed in mantle rock. The mantle rock is more or less reddish, calcareous or alkaline, clayey to loamy earth, similar in composition to the residuum from the clayey red beds.

The Tabler series can be considered as having soils belonging to two catenas, the one from clayey red beds, and the other from mantle rock. The catena developed from mantle rock consists of the Tabler, Calumet, Vanoss, and Norge soils. The other, heretofore discussed in detail, consists of the Tabler, Kirkland, Renfrow, and Vernon.

Another influence on the Tabler soils should be mentioned. They have developed mainly on broad level flats. Such a surface can hardly result purely from erosion; some sedimentation takes place. Consequently, Tabler profiles that developed from residuum weathered in place are rare. Possibly they do not exist.

Possibly the fairly thick silty A horizon of the Tabler series results partly from a thin mantle of loess deposited after the very dark-gray claypan had developed. Eolian mantles occur in belts along all the through-flowing major streams in western and central Oklahoma. These belts of eolian material are on the northeastern sides of the streams, or leeward to the prevailing southwesterly winds.

The streams have sand-choked channels bare of vegetation. Winds sweep up the silt and sand and form brownish dust clouds that drift leeward, occasionally for several miles. Near the streams the eolian mantles are ordinarily many feet of loose sand. They become thinner and less sandy to the northeast. At points 1 to 3 miles from the stream it can no longer be determined whether or not more recent wind-blown material has been incorporated in the surface layer of an older, well-developed soil. Nevertheless, there are other indications that loess has influenced the Tabler and other well-developed soils.

Around Enid (Garfield County), about 25 miles west of the main areas of Tabler soils in Noble County, there is a belt of eolian sands considerably distant from any present stream that could supply the sand. The soils in this belt are well developed, mainly of the Pratt series.

As further evidence, there are large areas of Tabler soils in Garfield County that are apparently westward continuations of the principal Tabler areas in Noble County. These were shown as Osewego silt loam in the soil survey of Garfield County, but would now be mapped as Tabler silt loam. The Tabler soils in Garfield County have some mantling of eolian silts, at least in the more western parts that flank areas of Pratt soils.

Similarly, in many places where Kirkland silt loam adjoins the Tabler, the surface soil of the Kirkland is a silt loam more than 14 inches deep over the claypan. In these places the Kirkland soil shows a transition from the friable surface soil to the claypan, not the normal rather abrupt change. Actually, these areas showing the transition to the claypan are Bethany silt loam, a soil not mapped separately in this county. These Bethany areas may show a thin mantling of loess.

SOILS FROM SANDY SHALES AND FINE-GRAINED SANDSTONES, ALLUVIUM, AND WINDBLOWN MATERIALS

Several sequences of soil series, or catenas, have developed on parent materials other than the clayey red beds already discussed. The Chickasha (Reddish Prairie) and Lucien (Lithosol) soils developed from reddish noncalcareous sandy shales and soft fine-grained sandstones. Development took place under a cover of grass.

The Stephenville (Red Podzolic) and Darnell (Lithosol) soils developed in materials similar to those of the Chickasha and Lucien, but under scrub-oak forest.

The Calumet, Vanoss, and Norge form a catena of soils developed in silty, more or less reddish, alluvial or windblown deposits. They formed under the influence of a grass cover.

The Kay and Port soils are youthful. They formed in moderately heavy alluvium in places where fresh alluvium is very slowly deposited.

Representative profiles for some of the important soil series are described in the following pages.

Chickasha loam (about ¼ mile W. of SE. corner sec. 32, T. 2 N., R. 2 E.)

This area of Chickasha loam is on a slightly convex, well-drained upland prairie slope of 3 percent. It is underlain by reddish Permian sandy shales and fine-grained soft sandstones or packsands.

Profile description:

A_1 0 to 10 inches, dark grayish-brown (10YR 4/2; 3/2, moist) loam; friable; moderate medium granular; medium acid.

A_3 10 to 16 inches, brown (10YR 4/3) clay loam; strong medium granular; friable; medium acid.

and
B_1

B_2 16 to 32 inches, brown (7.5YR 4/4) friable sandy clay coarsely mottled with reddish brown or yellowish red; mottles increase in number and size with depth and are confined largely to interiors of aggregates; layer is coarse granular above but at about 25 inches grades to moderate medium blocky; slightly or medium acid in upper part but becomes neutral in lower part.

B_3 32 to 50 inches, coarsely mottled yellowish-brown, reddish-brown, and grayish-brown friable noncalcareous sandy clay.

C 50 to 60 inches +, partly weathered sandy shale; noncalcareous though mildly alkaline; this material is part of the Wellington formation.

Gowen silt loam (¼ mile W. of NE. corner sec. 14, T. 23 N., R. 1 W.)

This soil is in a 200-foot wide flood plain of a small intermittent stream that drains a watershed consisting mainly of Kirkland and Renfrow silt loams. It is level, and well drained except during occasional brief inundations that do not interfere greatly with crop production. The soil was in native pasture, largely buffalograss and grama, but the original cover was tall prairie grasses.

Profile description:

A_1 0 to 18 inches, dark grayish-brown (10YR 4/2; 3/2, moist) silt loam; friable; strong medium granular; neutral; grades indistinctly into material beneath.

C_1 18 to 30 inches, grayish-brown (10YR 5/2; 3/2, moist) silt loam; friable; moderate coarse granular; neutral; rests abruptly on layer beneath.

D_1 30 to 45 inches, dark grayish-brown (10YR 3.5/2; 2.5/2, moist) silt loam; strong coarse granular; neutral; evidently the A_1 horizon of a buried soil.

D_2 45 to 54 inches +, grayish-brown (10YR 5/2) friable silt loam of neutral reaction.

Dark layers representing buried soils, such as the D_1 in the profile just described, occur erratically at variable depths in Gowen soil, or may not appear at all.

Kay silty clay loam

This soil is in a level slowly drained area on the flood plain of Red Rock Creek. It is inundated once in 10 to 25 years. The field has been cultivated some 50 years; the original vegetation probably was mainly tall prairie grasses and a few scattered trees.

Profile description:

1. 0 to 20 inches, dark-brown (7.5YR 3/1.5; 2.5/2, moist) silty clay loam; friable; strong medium granular; neutral.
2. 20 to 30 inches, black (10YR 2.5/2; 2/2, moist) clay; firm to very firm; very plastic; moderate medium granular; granules very firm and have slightly varnished exteriors when moist but adhere firmly to one another; mildly alkaline but noncalcareous.
3. 30 to 48 inches, dark-brown (7.5YR 3/2; 2.5/2, moist) firm noncalcareous clay.
4. 48 to 60 inches, dark reddish-brown (5YR 3/3; 2.5/3, moist) firm noncalcareous clay.
5. 60 to 75 inches +, reddish-brown (5YR 4/3; 2.5/3, moist) friable silty clay loam; mildly alkaline but noncalcareous.

Lucien very fine sandy loam (⅝ mile E. of SW. corner of sec. 12, T. 21 N., R. 1 E.):

This soil has a convex surface of 3 percent and is on upland prairie underlain by red, soft, fine-grained, noncalcareous Permian sandstones and sandy shales of the Wellington formation.

Profile description:

A_1 0 to 10 inches, reddish-brown (2.5YR 4/3; 3/3, moist) very fine sandy loam; very friable; moderate medium granular, pH 6.0; grades to horizon beneath.

A_3 10 to 18 inches, reddish-brown (2.5YR 4/4; 3/4, moist) very fine sandy loam; very friable; compound moderate very coarse prismatic and medium granular; pH 6.0; grades through several inches of weathered packsand into material beneath.

C 18 to 30 inches +, reddish-brown (2.5YR 4/4) noncalcareous fine-grained soft sandstone or packsand; about neutral in reaction; contains pockets or lenses of yellowish-brown packsand; underlain by, and interbedded with, red clays and silty shales.

Vanoss silt loam (1,000 ft. N. of SE. corner sec. 15, T. 21 N., R. 2 W.)

This area of Vanoss silt loam is on a nearly level or very slightly convex, freely drained upland surface, a flat interstream divide some 40 feet above the flood plains of Black Bear Creek and its major tributaries. The field has been cultivated since about 1900 but the soil was originally covered with tall prairie grasses. The area is an undissected part of a constructional plain underlain by Pleistocene alluvium. It appears to have a surface mantle of loess now altered into soil, and seems to lie at the same topographic level as the broad upland flats of Tabler soils in eastern Garfield, eastern Grant, and western Noble Counties. The associated dissected gentle slopes to the streams are largely Norge soils.

Profile description:

A_1 0 to 18 inches, brown (7.5YR 4/3; 3/3, moist) silt loam free from medium or coarse sand; friable; strong medium granular at lower depths; strongly acid in plowed layer, medium acid at 12 inches, slightly acid at the base of horizon; grades into the B_2 horizon through a transition 5 inches thick.

B_2 18 to 40 inches, brown (7.5YR 4.5/4; 3.5/4, moist) silty clay loam; strong medium granular in upper part, and strong coarse granular in lower; individual granules firm but a mass of granules is friable or very friable; slightly acid; grades to horizon beneath.

B_3 (?) 40 to 50 inches, yellowish-red (5YR 4/6) heavy silty clay loam coarsely mottled with yellowish brown (10YR 5/4); firm when moist, very hard when dry; strong blocky; contains a few soft, very dark-brown ferro-manganese concretions; slowly permeable; slightly acid.

C_2 (?) 50 to 90 inches, red (2.5YR 4.5/5; 4/6, moist) silty clay; free from evident grit or medium to coarse sand; firm or very firm; slightly acid.

D (?) 90 to 110 inches +, red (2.5YR 4/6) mildly alkaline but not calcareous clay loam; contains appreciable sand and grit; Pleistocene (?) alluvium of undetermined thickness, evidently not more than 30 feet deep over red Permian shales.

Norge silt loam (200 ft. NE. of SW. corner sec. 11, T. 21 N., R. 2 W.):

This area of Norge silt loam is in native pasture consisting of short grasses. The original cover was mainly tall grasses. The soil is on the smoothly dissected margin of the constructional plain. The surface is convex, has slopes of about 2 percent, and is about 5 feet below the surface of the constructional plain if the plain were projected. Downslope, the B_3 horizon becomes less clayey and more friable. At 100 feet down the slope the B_3 is silty clay loam. Red Permian shales that underlie the mantle in which this soil has developed are exposed in a draw 500 to the east, some 30 feet lower stratigraphically. The contact of the mantle and the shales is masked by creep.

Profile description:

A_1 0 to 6 inches, brown (7.5YR 4/3; 3.3, moist) silt loam; friable; moderate medium granular; medium acid.

A_2 and B_1 6 to 16 inches, reddish-brown (5YR 4/3; 3/3, moist) silt loam above grading to silty clay loam below; strong medium granular; friable with firm granules; strongly acid to medium acid; grades to horizon beneath.

B_2 16 to 25 inches, reddish-brown (5YR 5/4; 4/4, moist) silty clay loam; firm when moist, hard when dry; weak to moderate blocky; medium acid.

B_3 25 to 35 inches, red (2.5YR 4/5; 4/6, moist) silty clay free of observable medium or coarse sand; firm to very firm; strong coarse prismatic; vertical faces of aggregates coated with brown (7.5YR 4/2) films; contains a few soft very dark brown ferruginous concretions; mildly alkaline but noncalcareous.

C_1 35 to 65 inches, red (2.5YR 5/6; 4/6, moist) noncalcareous silty clay; firm; mildly alkaline.

C_2 65 to 120 inches +, red (2.5YR 5/6) noncalcareous friable silty clay loam; mildly alkaline; probably alluvium but possibly eolian. (Pleistocene alluvium containing waterworn pebbles exposed in road ditch 200 feet down the slope.)

ADDITIONAL FACTS ABOUT NOBLE COUNTY

AGRICULTURE

Noble County was one of the last frontiers of the United States. It was part of an area of the Oklahoma Indian Territory, established in 1834, but never settled by the Indians. This area reverted to the United States Government by cession and purchase from the Indians. This large area was opened to the public in sections from 1889 to 1893 and settled by a series of spectacular runs. What is now Noble County was settled in one day in units of 160 acres.

The settlers had gathered from nearly every State and Territory in the nation. Most of them, however, were from the nearby States of Kansas, Texas, Missouri, and Arkansas, and from the middle western States. They were fairly well informed regarding the agriculture of the region.

These early settlers followed a subsistence type of farming; they grew as much of their own food as possible. Livestock was an important part of the farm program. More specialized types of farming became possible as transportation improved and heavy labor-saving machinery became available for handling large harvests.

Most of the people have made their livelihood from the land and have been interested in productive soils. The high yields obtained when the native prairie sod was first plowed have gradually declined with the lowering of the organic-matter content of the soils. Little has been done to increase yields again, though high production rates are possible on many soils. At the time of this survey, agriculture was fairly prosperous, especially on the more productive soils and in the cattle-ranching areas.

In 1950, the agriculture of the area was based largely on the production of wheat, hay, oats, sorghums, and corn. Livestock production is dominant in the Otoe Indian Reservation, located in the east-central part of the county, and also on the rolling lands of the southwest.

CROPS

Until 1910 corn and wheat were the principal crops. Since that time the wheat acreage has been increasing at the expense of the corn acreage. By 1950, the corn acreage had decreased to the extent that it was exceeded by acreages planted to wheat, oats, sorghums, and alfalfa. The acreage planted to sorghums increased around 1920 and took part of the acreage that had been in corn. Cotton acreage dropped rather sharply during the 1930's. The barley acreage is low, probably because chinch bugs prefer it as a winter shelter and food supply. A considerable quantity of barley was grown in 1940, partly because winter-hardy varieties were then introduced. The rye acreage has been low. Fruit trees of nearly all types have shown a decrease in each successive census since 1920. Table 8 shows the acreages of principal crops in stated census years.

TABLE 8.—*Acreage of principal crops in Noble County, Okla.*

Crop	1919	1929	1939	1949
	Acres	*Acres*	*Acres*	*Acres*
Corn for all purposes	7, 421	22, 862	3, 711	3, 556
Small grains threshed or combined:				
Wheat	135, 429	102, 098	129, 152	140, 429
Oats	43, 877	31, 026	20, 220	15, 201
Barley	600	533	11, 814	284
Rye	186	(1)	755	17
All hay	26, 444	23, 580	17, 174	19, 762
Alfalfa	10, 037	3, 624	3, 655	6, 625
Clover or timothy	5	5	(1)	189
Annual legumes cut for hay	55	87	62	72
Small grains cut green	567	108	415	501
Tame hay	1, 217	534	4, 233	2, 226
Wild hay	14, 563	19, 222	8, 809	10, 149
Cotton	1, 351	6, 946	1, 965	2, 888
Sorghum:				
Harvested for grain	6, 104	6, 397	1, 758	4, 023
Cut for hay	5, 135	5, 651	3, 147	4, 031
Potatoes	261	189	189	[2] 25
Sweetpotatoes	40	15	(3)	(4)
All vegetables for sale	27	64	54	9

[1] Not reported.
[2] For 1949, does not include acres for farms with less than 15 bushels harvested.
[3] Less than 1 acre.
[4] Reported in small fractions of an acre.

Wheat.—Winter wheat is now the principal cash crop and dominates in the agriculture on many farms, especially on the smooth, heavy lands of the central and northern parts of the county. The ground is generally plowed with a disk or moldboard gangplow soon after harvest. This kills weeds and puts the soil in condition to absorb moisture. After rains have caused weed growth, the land is stirred with a one-way disk or a springtooth harrow. This disking or harrowing is repeated in early fall to kill weeds and volunteer grain. The wheat is drilled between September 15 and October 15. It is seeded earlier if pasture is wanted. During some years, the pasture is worth as much as the grain. The seed is drilled at the rate of about 3 or 4 pecks per acre. Light seeding is preferable in dry years.

During wetter seasons, wheat is sometimes sown following row crops without any preparation of the land. This is fairly successful after corn or cotton but is not so good after sorghums.

Yields of wheat are much better if the crop follows a legume (pl. 7).

Small grains are almost always harvested with a combine. In Red Rock Creek bottom, however, the binder is used to start the harvest as soon as the crop is ready. Harvest is started with a binder to avoid the risk of flooding as much as possible. During wet seasons, some fields of wheat have been known to wait for harvesting as long as 5 weeks from the time the grain was ripe enough to cut. For this reason, varieties that stand well for a long time are desirable. More care is taken to harvest oats at the time the crop becomes ripe. This is possible because oats are not grown so extensively as wheat.

Binders can start work 7 to 10 days earlier than combines, and, in some cases, can save a crop that might be damaged during the 10-day wait before combining is possible. Wheat harvesting is usually completed by July 15, though in wet years it may be 2 or 3 weeks later.

A large part of the wheat is hauled to the elevator and sold immediately after harvest. In general, this has been more profitable than farm storage, unless prices were definitely on the upgrade. Local elevators are better equipped for storage than farmers, as a rule, and are able to protect themselves against price fluctuations by hedging operations. The grain is later shipped to flour mills in Enid, Oklahoma City, Stillwater, Ponca City, and Newkirk.

Oats.—Spring-sown oats are handled much the same as wheat but are planted at the rate of about 2 bushels per acre between February 15 and March 15. Oats are usually harvested a few days later than wheat. Fall-sown oats are likely to freeze out in this section, though high yields are often obtained when they do survive. The Oklahoma Agricultural Experiment Station has recently developed a number of more winter-hardy varieties that are promising. Early preparation of the seedbed is not so desirable with oats, because this exposes the soil to washing and erosion. Oats often follow row crops, such as corn or cotton, without the land being plowed. It is merely disked and the oats drilled or sown by hand.

Corn.—Cornland is listed or plowed late in fall or late in winter, and lister ridges are broken by a lister planter while planting the corn. As a rule, the crop is planted in the bottom of the furrow made by the lister planter. In cultivation, this planting furrow is gradually filled and the space between rows becomes a furrow. The weeds and grass are hoed out of the corn. From one to four cultivations are given the crop. Corn is planted between April 1 and 15. Corn matures in mid-July, and harvest normally extends from about September 1 to December 1. Most of the corn is picked and shucked by hand and thrown into a wagon drawn by horses, mules, or a tractor. This crop is very responsive to good management.

Alfalfa.—Alfalfa is rather exacting as to soil requirements and is therefore grown mainly on the alluvial bottoms and low terraces. The land is plowed and worked into a fine seedbed, and the alfalfa seed is scattered with a grass seeder, by hand, or, in some cases, by an end-gate seeder on a wagon. It is sown at the rate of 20 pounds per acre between August 15 and September 15.

Usually about four cuttings of hay are obtained except in the first year, when only three are obtained. The crop lasts from 5 to 8 years before it becomes weedy and of low value. Alfalfa is a fairly dependable crop, but seed is expensive. The development of methods of alfalfa silage production may cause this crop to become more popular.

Cotton.—Land for cotton is generally plowed late in winter or early in spring. The seed is planted by one- or two-row planters from about April 15 to May 1. It is thinned with a hoe and given about three cultivations and two hoeings. Cotton picking starts in September and continues until December.

GENERAL CROPPING PRACTICES

Systematic rotations are not commonly used in this section, although the crop grown is occasionally changed to different fields. Fertilizers are not generally used, although they could be used to advantage on some soils, especially in the southeast. Use of agricultural lime and phosphate fertilizers has increased markedly since 1939. In 1950 there were 2,652 tons of fertilizers of all grades used, a large proportion of which was superphosphate and rock phosphate. During the same year, 6,459 tons of lime were added to 3,300 acres of land.

PASTURE

About 185,000 acres, equal to about 39 percent of the county, is in pasture. Permanent pastures are extensive in the Otoe Indian Reservation, in the east, and on the rolling lands of the southwest, east-central, and extreme northeast. These permanent pastures are of good quality when not overstocked and if mowed occasionally to control undesirable weeds. Buffalograss, grama, and bluestem predominate.

The small pastures on diversified farms are often severely overgrazed; only buffalograss and weeds remain.

Pasture management ranges from bad to very good. On ranch land and grazing land owned by the Indians on the Otoe Reservation, grazing is regulated and the land is seldom overstocked. The maximum rate of stocking is 4 acres per cow for the better pastures. The rate is about 8 acres per cow during the dry seasons. As a result, the Reservation pastures are in good condition and have a heavy cover of bluestem and other grasses and few weeds. Cattle are generally rotated from one pasture to another as soon as the grass has been cropped down. Cattlemen and stockmen usually follow these practices on their lands.

Not many farmers, however, try to improve their pastures. During the wet season pastures may be properly stocked; but the same number of animals is allowed to remain in the dry season and during droughts. The land is therefore seriously overstocked. As a result, the tall grasses are killed in most of the farm pastures, and only the short grasses and weeds remain.

Native pastures are grazed the year round but are green only from about April 1 to July 15, and from September through October. Pastures may stay green all summer if rains come late in July and in August. Wheat pasture is green all winter and is grazed from October 15 or November 1 to March 15. Supplemental feed is needed for part of the winter, especially during the more severe northers and following snows.

In the more seriously overgrazed areas, even the short grasses have been killed, and only weeds are left. Farmers often turn their stock into pastures in the wet weather to protect wheatlands used for pasture from tramping. Much of the grass is destroyed by such a practice if pastures are heavily stocked.

Some of the farmers use better management. They keep the stock in feedlots during wet weather; use a lower rate of stocking; use pasture rotation; keep sheep to reduce weeds, or mow once or twice a year to prevent weed seeding. Farmers using these practices are rewarded with cleaner pastures, greater gains in livestock weight per acre, and less soil loss from erosion (pl. 8).

LIVESTOCK

Sale of all livestock products accounted for nearly half the farm income in 1950. The number of cattle on farms has increased steadily since 1920. The number of swine has decreased along with the decrease in acreage of corn. Table 9 shows the number of livestock on farms in stated census years.

Cattle kept mainly for beef greatly outnumbered dairy cattle. Raising of beef is most common in the southwestern, east-central, and northeastern parts. The principal breeds are Hereford, Angus, and Shorthorn. To some extent, beef cattle are marketed locally, but greater numbers are trucked to Oklahoma City, Wichita, and Ponca City.

Most of the dairy farms are near Perry and the smaller towns. The principal breeds are Jersey, Milking Shorthorn, and Holstein. For the most part, dairy products are marketed in local population centers. Cream trucks run along regular routes.

Swine were reported on about 32 percent of the farms in 1950. They are fairly well distributed but are probably less common in the cash-grain sections in the northwestern part and on the Otoe Reservation. The main breeds are Duroc-Jersey and Poland China. Most of the hogs are marketed locally, but a few are shipped to Oklahoma City and Ponca City.

Chickens are kept on many farms, but few farmers specialize in poultry raising. A few turkeys, ducks, and geese are raised, mainly for home use. Turkeys are reported on 45 farms in 1949, and 5,410 turkeys were raised in 1950.

TABLE 9.—*Livestock on farms of Noble County, Okla., in stated years*

Livestock	1920	1930	1940	1950
Horses	10, 417	7, 213	[1] 3, 198	1, 651
Mules	2, 540	2, 088	[1] 577	69
Cattle	25, 666	26, 141	[1] 32, 682	36, 203
Swine	8, 629	11, 829	[2] 4, 753	5, 799
Sheep	1, 837	5, 696	[3] 5, 695	2, 084
Chickens	143, 483	154, 648	114, 333	112, 410

[1] Over 3 months old. [2] Over 4 months old. [3] Over 6 months old.

LAND USE

As shown in table 10, shifts in land use have taken place in the period 1929–49. The decrease of about 97,000 acres in cropland used for all purposes has been partly offset by an increase of about 55,000 acres in land pastured. Nevertheless, total land in farms has dropped about 46,000 acres in the 20-year period.

A fairly steady increase in average size of farms has accompanied the decrease in acreage of land in farms. In 1950 the average farm was 295.7 acres in size, as compared to 225.5 acres in 1930. Increase in number of cattle and greater use of power-driven machinery are no doubt reflected in the steady increase in size of farms.

TABLE 10.—*Land in farms in Noble County, Okla.*[1]

Land use	1929	1949
	Acres	*Acres*
Cropland harvested	202, 344	192, 969
Cropland used only for pasture	67, 823	10, 266
Cropland not harvested and not pastured	47, 674	17, 477
Woodland pastured	15, 334	10, 175
Woodland not pastured	7, 017	4, 685
Other land pastured (not cropland and not woodland)	114, 061	169, 652
All other land	19, 559	22, 078
Total	473, 812	427, 302

[1] For 1929 census includes crop failure, 29,331 acres; and cropland, idle or fallow, 18,343. For 1949 census, includes crop failure and cropland idle or fallow.

FARM TENURE

In 1950 owners and part owners operated 58.3 percent of the farms in the county, and tenants, 41.7 percent. Tenancy was lower in 1950 than in any census year since 1920.

Cash tenants operated about one-fifth of the rented farms in 1950. The next largest group were the share-crop tenants. Under the customary share contracts, the landlord gets one-fourth of the cotton crop, one-third of all other crops, and a cash bonus in addition. If the landlord furnishes machinery, livestock, and seed, he gets half of the crops.

TYPES OF FARMS

In 1950 the farms of Noble County were grouped by type as follows:

	Number
Field-crop farms other than vegetable and fruit-and-nut:	
Cash grain	484
Other	40
General farms:	
Crop and livestock	243
Primarily livestock	70
Primarily crops	26
Livestock other than dairy and poultry	198
Dairy	119
Poultry	31
Miscellaneous and unclassified	234
Total	1, 445

The cash-grain farms are mainly in the northwest on the smooth soils that have a heavy clay subsoil. Livestock farms and ranches are located mainly in the southwestern, east-central, and northeastern parts where the soils are rolling and many of them are shallow. The dairy farms are on similar soils, but normally fairly close to towns. The general farms and cotton farms are mainly on the stream bottoms, and in the southeast, where the soils are smooth to undulating, friable, and fairly deep.

FARM EQUIPMENT

Tractors have largely replaced horses and mules on the bigger farms. In 1950 there were 1,543 tractors reported on the 1,445 farms in the county. Large tractors and combines are used to some extent in the northwest. Medium-sized tractors of the row-crop type and the light, all-crop type of combine are popular elsewhere. There were 1,331 automobiles and 990 motortrucks on farms in 1950.

A few farmers own stalk cutters, threshing machines, hay balers, binders, and feed grinders. They rent these to other farmers for short periods or do custom work at a fixed price. Joint ownership is not customary.

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL MAP
NOBLE COUNTY - OKLAHOMA
SHEET NO. 1

OKLAHOMA AGRICULTURAL EXPERIMENT STATION

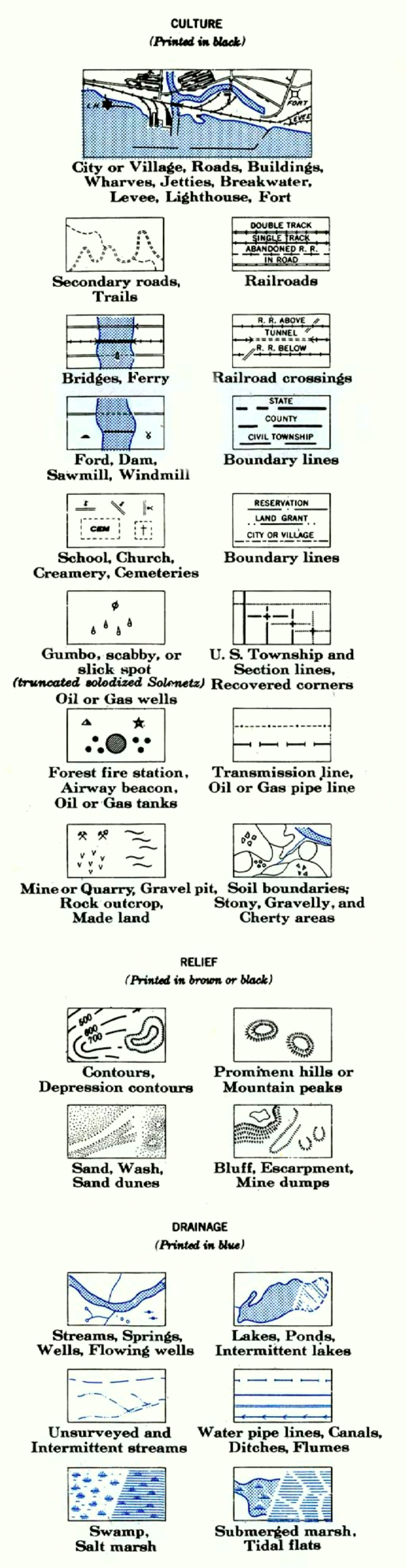
LEGEND

- **Aa** Albion loam, 2-5 percent slopes
- **Ab** Albion loam, eroded, 5-8 percent slopes
- **Ba** Broken land, Reinach soil material, 20+ percent slopes
- **Cb** Calumet silty clay loam, 0-1 percent slopes
- **Ca** Calumet-Drummond silt loams, 0-1 percent slopes
- **Cd** Canadian fine sandy loam, 0-3 percent slopes
- **Cc** Canadian fine sandy loam, 3-5 percent slopes
- **Cg** Chickasha loam, 0-3 percent slopes
- **Ce** Chickasha loam, 3-5 percent slopes
- **Cf** Chickasha loam, eroded, 3-5 percent slopes
- **Ch** Chickasha loam, 5-10 percent slopes
- **Ck** Chickasha loam, eroded, 5-10 percent slopes
- **Da** Dale silt loam, 0-1 percent slopes
- **Db** Darnell-Stephenville fine sandy loams, 3-10 percent slopes
- **Dc** Derby loamy fine sand, 3-7 percent slopes
- **Ga** Gowen silt loam, 0-1 percent slopes
- **Gb** Gowen silty clay loam, 0-1 percent slopes
- **Kb** Kay silty clay loam, 0-1 percent slopes
- **Ke** Kirkland silt loam, 0-2 percent slopes
- **Kc** Kirkland silt loam, 2-4 percent slopes
- **Kd** Kirkland silt loam, eroded, 2-4 percent slopes
- **Ka** Lela clay, 0-1 percent slopes
- **La** Lucien stony loam, 3-10 percent slopes
- **Lb** Lucien very fine sandy loam, 3-5 percent slopes
- **Lc** Lucien very fine sandy loam, 5-10 percent slopes
- **Ld** Lucien very fine sandy loam, eroded, 5-8 percent slopes
- **Ma** Miller clay, 0-1 percent slopes
- **Mb** Miller silty clay loam, 0-1 percent slopes
- **Na** Vanoss silt loam, 0-1 percent slopes
- **Nb** Norge silt loam, 1-5 percent slopes
- **Nc** Norge silt loam, eroded 1-5 percent slopes
- **Nd** Norge silt loam, 5-8 percent slopes
- **Ne** Norge silt loam, eroded, 5-8 percent slopes
- **Oa** Oil-waste land
- **Ob** Owens clay, 5-10 percent slopes
- **Ra** Port silt loam, 0-1 percent slopes
- **Rb** Port silty clay loam, 0-1 percent slopes
- **Re** Renfrow silt loam, 1-2 percent slopes
- **Rc** Renfrow silt loam, 2-4 percent slopes
- **Rd** Renfrow silt loam, eroded, 2-4 percent slopes
- **Rf** Renfrow silty clay loam, 2-4 percent slopes
- **Rg** Renfrow silty clay loam, eroded, 2-4 percent slopes
- **Rh** Rough broken land, Norge soil material, 10+ percent slopes
- **Rk** Rough broken land, Vernon soil material, 10+ percent slopes
- **Rl** Rough stony land, Darnell soil material, 10+ percent slopes
- **Sa** Sogn stony clay loam, 5-30 percent slopes
- **Sb** Summit silty clay loam, 1-3 percent slopes
- **Tb** Tabler silt loam, 0-1 percent slopes
- **Ta** Tabler silt loam, eroded, 1-3 percent slopes
- **Va** Vernon clay loam, 4-10 percent slopes
- **Ya** Yahola silt loam, 0-1 percent slopes

COLOR GROUPING

▨	Cb	Calumet silty clay loam, 0-1 percent slopes
	Ke	Kirkland silt loam, 0-2 percent slopes
	Re	Renfrow silt loam, 1-2 percent slopes
	Tb	Tabler silt loam, 0-1 percent slopes
▨	Kc	Kirkland silt loam, 2-4 percent slopes
	Kd	Kirkland silt loam, eroded, 2-4 percent slopes
	Rc	Renfrow silt loam, 2-4 percent slopes
	Rd	Renfrow silt loam, eroded, 2-4 percent slopes
	Rf	Renfrow silty clay loam, 2-4 percent slopes
	Rg	Renfrow silty clay loam, eroded, 2-4 percent slopes
	Ta	Tabler silt loam, eroded, 1-3 percent slopes
▨	Sb	Summit silty clay loam, 1-3 percent slopes
▨	Nb	Norge silt loam, 1-5 percent slopes
	Na	Vanoss silt loam, 0-1 percent slopes
▨	Nc	Norge silt loam, eroded, 1-5 percent slopes
	Nd	Norge silt loam, 5-8 percent slopes
	Ne	Norge silt loam, eroded, 5-8 percent slopes
■	Cg	Chickasha loam, 0-3 percent slopes
	Ce	Chickasha loam 3-5 percent slopes
▨	Cf	Chickasha loam, eroded, 3-5 percent slopes
	Ch	Chickasha loam, 5-10 percent slopes
	Ck	Chickasha loam, eroded, 5-10 percent slopes
■	Cd	Canadian fine sandy loam, 0-3 percent slopes
	Cc	Canadian fine sandy loam, 3-5 percent slopes
■	Dc	Derby loamy fine sand, 3-7 percent slopes
■	Aa	Albion loam, 2-5 percent slopes
	Ab	Albion loam, eroded, 5-8 percent slopes
▨	Ba	Broken land, Reinach soil material, 20+ percent slopes
	La	Lucien stony loam, 3-10 percent slopes
	Lb	Lucien very fine sandy loam, 3-5 percent slopes
	Lc	Lucien very fine sandy loam, 5-10 percent slopes
	Ld	Lucien very fine sandy loam, eroded, 5-8 percent slopes
	Oa	Oil-waste land
	Ob	Owens clay, 5-10 percent slopes
	Rh	Rough broken land, Norge soil material, 10+ percent slopes
	Rk	Rough broken land, Vernon soil material, 10+ percent slopes
	Sa	Sogn stony clay loam, 5-30 percent slopes
	Va	Vernon clay loam, 4-10 percent slopes
▨	Db	Darnell-Stephenville fine sandy loams, 3-10 percent slopes
	Rl	Rough stony land, Darnell soil material, 10+ percent slopes
■	Kb	Kay silty clay loam, 0-1 percent slopes
	Ma	Miller clay, 0-1 percent slopes
	Mb	Miller silty clay loam, 0-1 percent slopes
■	Ca	Calumet-Drummond silt loams, 0-1 percent slopes
	Ka	Lela clay, 0-1 percent slopes
■	Da	Dale silt loam, 0-1 percent slopes
	Ga	Gowen silt loam, 0-1 percent slopes
	Gb	Gowen silty clay loam, 0-1 percent slopes
	Ra	Port silt loam, 0-1 percent slopes
	Rb	Port silty clay loam, 0-1 percent slopes
	Ya	Yahola silt loam, 0-1 percent slopes

CONVENTIONAL SIGNS


CULTURE
(Printed in black)

City or Village, Roads, Buildings, Wharves, Jetties, Breakwater, Levee, Lighthouse, Fort

Secondary roads, Trails

Railroads

Bridges, Ferry

Railroad crossings

Ford, Dam, Sawmill, Windmill

Boundary lines

School, Church, Creamery, Cemeteries

Boundary lines

Gumbo, scabby, or slick spot *(truncated solodized Solonetz)* Oil or Gas wells

U. S. Township and Section lines, Recovered corners

Forest fire station, Airway beacon, Oil or Gas tanks

Transmission line, Oil or Gas pipe line

Mine or Quarry, Gravel pit, Rock outcrop, Made land

Soil boundaries; Stony, Gravelly, and Cherty areas

RELIEF
(Printed in brown or black)

Contours, Depression contours

Prominent hills or Mountain peaks

Sand, Wash, Sand dunes

Bluff, Escarpment, Mine dumps

DRAINAGE
(Printed in blue)

Streams, Springs, Wells, Flowing wells

Lakes, Ponds, Intermittent lakes

Unsurveyed and Intermittent streams

Water pipe lines, Canals, Ditches, Flumes

Swamp, Salt marsh

Submerged marsh, Tidal flats

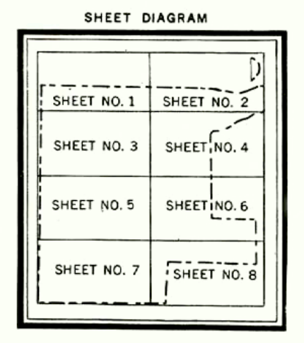
ACCELERATED EROSION
≈ Gully not crossable with farm equipment

J. Kenneth Ableiter, Chief Soil Correlator.
C. P. Barnes, Chief Analyst, Soil Uses and Productivity.
James Thorpe, Principal Soil Correlator, Great Plains States.
Area inspected by E. G. Fitzpatrick, Soil Correlator, and
E. H. Templin, Senior Soil Correlator.
Soils surveyed 1938-40 by O. H. Brensing, in Charge, and
E. C. Talley, Oklahoma Agricultural Experiment Station.

Scale 1:24,000

☆ U. S. GOVERNMENT PRINTING OFFICE : 1955 O—366000

SHEET DIAGRAM



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Map constructed by Division of Cartography,
Soil Conservation Service, USDA,
from 1937 aerial photographs.
Soils surveyed on 1937 aerial photographs.
Polyconic projection; 1927 North American datum.
10000-foot grid based on Oklahoma (North)
rectangular coordinate system.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL MAP
NOBLE COUNTY - OKLAHOMA
SHEET NO. 2

OKLAHOMA AGRICULTURAL EXPERIMENT STATION

LEGEND

Symbol	Soil
Aa	Albion loam, 2-5 percent slopes
Ab	Albion loam, eroded, 5-8 percent slopes
Ba	Broken land, Reinach soil material, 20+ percent slopes
Cb	Calumet silty clay loam, 0-1 percent slopes
Ca	Calumet-Drummond silt loams, 0-1 percent slopes
Cd	Canadian fine sandy loam, 0-3 percent slopes
Cc	Canadian fine sandy loam, 3-5 percent slopes
Cg	Chickasha loam, 0-3 percent slopes
Ce	Chickasha loam, 3-5 percent slopes
Cf	Chickasha loam, eroded, 3-5 percent slopes
Ch	Chickasha loam, 5-10 percent slopes
Ck	Chickasha loam, eroded, 5-10 percent slopes
Da	Dale silt loam, 0-1 percent slopes
Db	Darnell-Stephenville fine sandy loams, 3-10 percent slopes
Dc	Derby loamy fine sand, 3-7 percent slopes
Ga	Gowen silt loam, 0-1 percent slopes
Gb	Gowen silty clay loam, 0-1 percent slopes
Kb	Kay silty clay loam, 0-1 percent slopes
Ke	Kirkland silt loam, 0-2 percent slopes
Kc	Kirkland silt loam, 2-4 percent slopes
Kd	Kirkland silt loam, eroded, 2-4 percent slopes
Ka	Lela clay, 0-1 percent slopes
La	Lucien stony loam, 3-10 percent slopes
Lb	Lucien very fine sandy loam, 3-5 percent slopes
Lc	Lucien very fine sandy loam, 5-10 percent slopes
Ld	Lucien very fine sandy loam, eroded, 5-8 percent slopes
Ma	Miller clay, 0-1 percent slopes
Mb	Miller silty clay loam, 0-1 percent slopes
Na	Vanoss silt loam, 0-1 percent slopes
Nb	Norge silt loam, 1-5 percent slopes
Nc	Norge silt loam, eroded 1-5 percent slopes
Nd	Norge silt loam, 5-8 percent slopes
Ne	Norge silt loam, eroded, 5-8 percent slopes
Oa	Oil-waste land
Ob	Owens clay, 5-10 percent slopes
Ra	Port silt loam, 0-1 percent slopes
Rb	Port silty clay loam, 0-1 percent slopes
Re	Renfrow silt loam, 1-2 percent slopes
Rc	Renfrow silt loam, 2-4 percent slopes
Rd	Renfrow silt loam, eroded, 2-4 percent slopes
Rf	Renfrow silty clay loam, 2-4 percent slopes
Rg	Renfrow silty clay loam, eroded, 2-4 percent slopes
Rh	Rough broken land, Norge soil material, 10+ percent slopes
Rk	Rough broken land, Vernon soil material, 10+ percent slopes
Rl	Rough stony land, Darnell soil material, 10+ percent slopes
Sa	Sogn stony clay loam, 5-30 percent slopes
Sb	Summit silty clay loam, 1-3 percent slopes
Tb	Tabler silt loam, 0-1 percent slopes
Ta	Tabler silt loam, eroded 1-3 percent slopes
Va	Vernon clay loam, 4-10 percent slopes
Ya	Yahola silt loam, 0-1 percent slopes

COLOR GROUPING

Cb Calumet silty clay loam, 0-1 percent slopes
Ke Kirkland silt loam, 0-2 percent slopes
Re Renfrow silt loam, 1-2 percent slopes
Tb Tabler silt loam, 0-1 percent slopes

Kc Kirkland silt loam, 2-4 percent slopes
Kd Kirkland silt loam, eroded, 2-4 percent slopes
Rc Renfrow silt loam, 2-4 percent slopes
Rd Renfrow silt loam, eroded, 2-4 percent slopes
Rf Renfrow silty clay loam, 2-4 percent slopes
Rg Renfrow silty clay loam, eroded, 2-4 percent slopes
Ta Tabler silt loam, eroded, 1-3 percent slopes

Sb Summit silty clay loam, 1-3 percent slopes

Nb Norge silt loam, 1-5 percent slopes
Na Vanoss silt loam, 0-1 percent slopes

Nc Norge silt loam, eroded, 1-5 percent slopes
Nd Norge silt loam, 5-8 percent slopes
Ne Norge silt loam, eroded, 5-8 percent slopes

Cg Chickasha loam, 0-3 percent slopes
Ce Chickasha loam 3-5 percent slopes

Cf Chickasha loam, eroded, 3-5 percent slopes
Ch Chickasha loam, 5-10 percent slopes
Ck Chickasha loam, eroded, 5-10 percent slopes

Cd Canadian fine sandy loam, 0-3 percent slopes
Cc Canadian fine sandy loam, 3-5 percent slopes

Dc Derby loamy fine sand, 3-7 percent slopes

Aa Albion loam, 2-5 percent slopes
Ab Albion loam, eroded, 5-8 percent slopes

Ba Broken land, Reinach soil material, 20+ percent slopes
La Lucien stony loam, 3-10 percent slopes
Lb Lucien very fine sandy loam, 3-5 percent slopes
Lc Lucien very fine sandy loam, 5-10 percent slopes
Ld Lucien very fine sandy loam, eroded, 5-8 percent slopes
Oa Oil-waste land
Ob Owens clay, 5-10 percent slopes
Rh Rough broken land, Norge soil material, 10+ percent slopes
Rk Rough broken land, Vernon soil material, 10+ percent slopes
Sa Sogn stony clay loam, 5-30 percent slopes
Va Vernon clay loam, 4-10 percent slopes

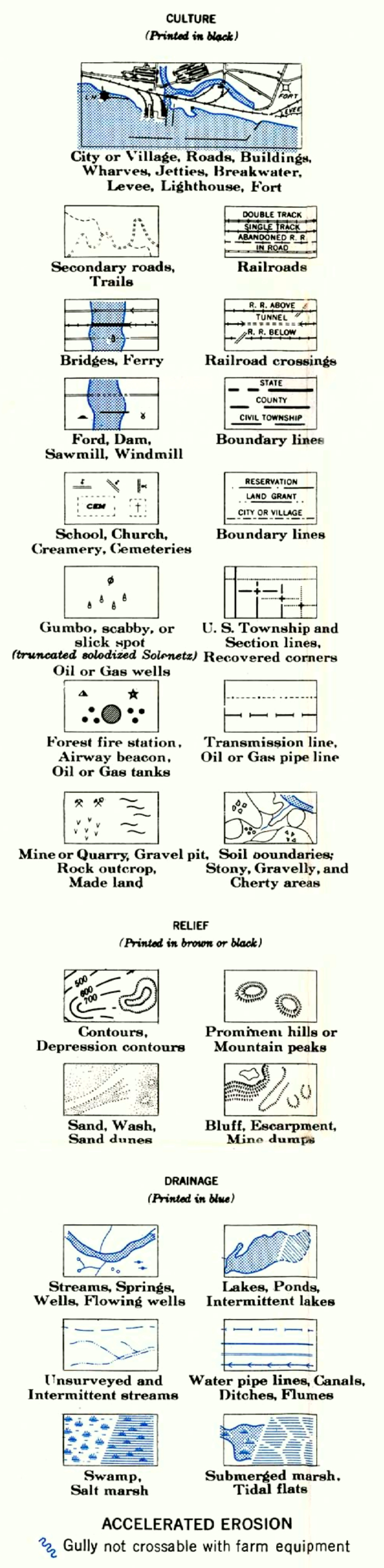
Db Darnell-Stephenville fine sandy loams, 3-10 percent slopes
Rl Rough stony land, Darnell soil material, 10+ percent slopes

Kb Kay silty clay loam, 0-1 percent slopes
Ma Miller clay, 0-1 percent slopes
Mb Miller silty clay loam, 0-1 percent slopes

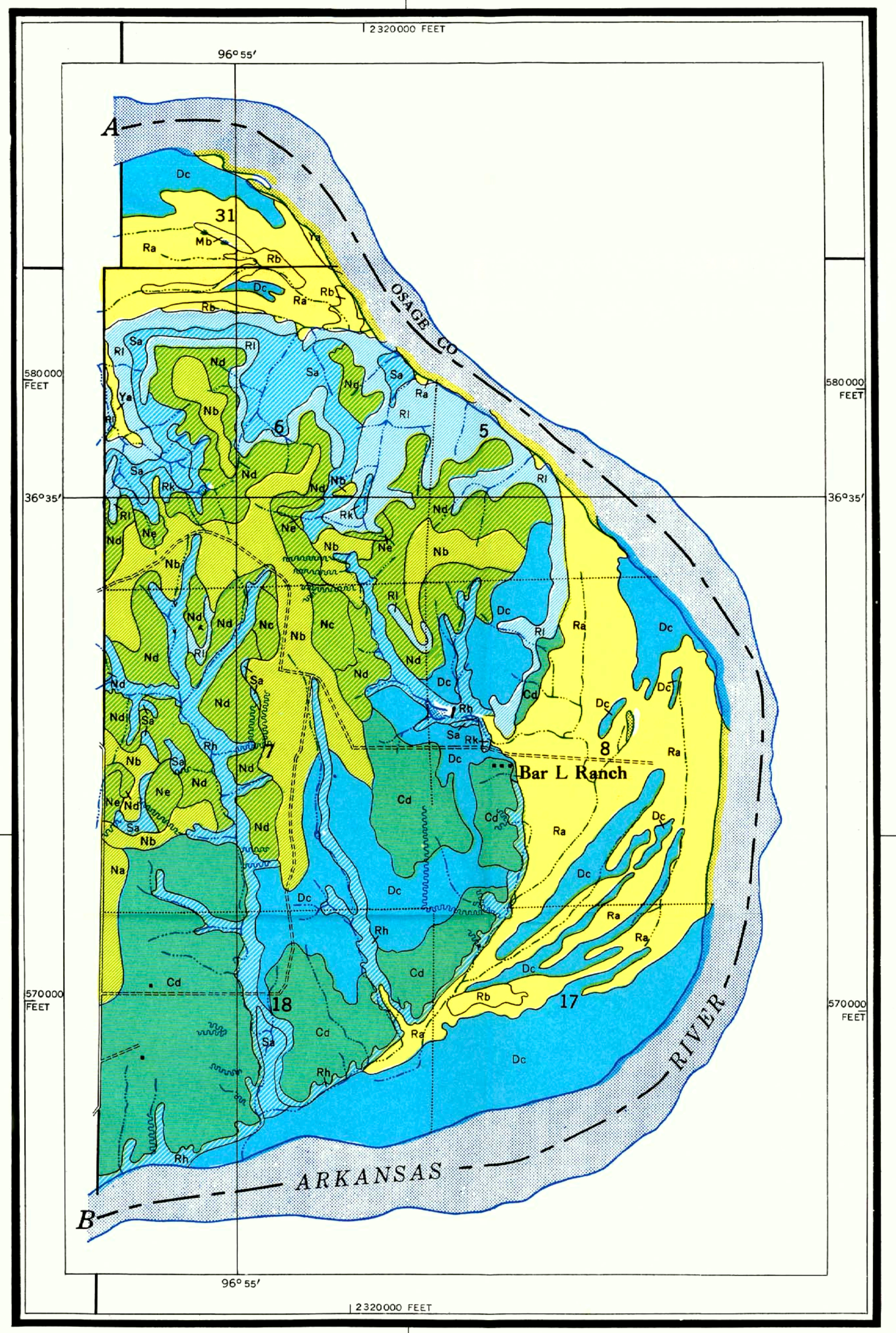
Ca Calumet-Drummond silt loams, 0-1 percent slopes
Ka Lela clay, 0-1 percent slopes

Da Dale silt loam, 0-1 percent slopes
Ga Gowen silt loam, 0-1 percent slopes
Gb Gowen silty clay loam, 0-1 percent slopes
Ra Port silt loam, 0-1 percent slopes
Rb Port silty clay loam, 0-1 percent slopes
Ya Yahola silt loam, 0-1 percent slopes

CONVENTIONAL SIGNS


CULTURE
(Printed in black)
City or Village, Roads, Buildings, Wharves, Jetties, Breakwater, Levee, Lighthouse, Fort
Secondary roads, Trails
DOUBLE TRACK
SINGLE TRACK
ABANDONED R. R.
IN ROAD
Railroads
Bridges, Ferry
R. R. ABOVE
TUNNEL
R. R. BELOW
Railroad crossings
Ford, Dam, Sawmill, Windmill
STATE
COUNTY
CIVIL TOWNSHIP
Boundary lines
CEM
School, Church, Creamery, Cemeteries
RESERVATION
LAND GRANT
CITY OR VILLAGE
Boundary lines
Gumbo, scabby, or slick spot (truncated solodized Solonetz) Oil or Gas wells
U. S. Township and Section lines, Recovered corners
Forest fire station, Airway beacon, Oil or Gas tanks
Transmission line, Oil or Gas pipe line
Mine or Quarry, Gravel pit, Rock outcrop, Made land
Soil boundaries; Stony, Gravelly, and Cherty areas
RELIEF
(Printed in brown or black)
500
600
700
Contours, Depression contours
Prominent hills or Mountain peaks
Sand, Wash, Sand dunes
Bluff, Escarpment, Mine dumps
DRAINAGE
(Printed in blue)
Streams, Springs, Wells, Flowing wells
Lakes, Ponds, Intermittent lakes
Unsurveyed and Intermittent streams
Water pipe lines, Canals, Ditches, Flumes
Swamp, Salt marsh
Submerged marsh, Tidal flats

ACCELERATED EROSION
〰 Gully not crossable with farm equipment



J. Kenneth Ableiter, Chief Soil Correlator.
C. P. Barnes, Chief Analyst, Soil Uses and Productivity.
James Thorpe, Principal Soil Correlator, Great Plains States.
Area inspected by E. G. Fitzpatrick, Soil Correlator, and
E. H. Templin, Senior Soil Correlator.
Soils surveyed 1938-40 by O. H. Brensing, in Charge, and
E. C. Talley, Oklahoma Agricultural Experiment Station.

Scale 1:24,000

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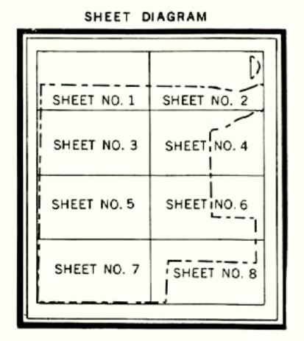

Alphabetical Legend, Color Grouping, and Conventional Signs are located on sheets. 1, 2, and 8.

Map constructed by Division of Cartography, Soil Conservation Service, USDA, from 1937 aerial photographs.
Soils surveyed on 1937 aerial photographs.
Polyconic projection, 1927 North American datum.
10 000-foot grid based on Oklahoma (North) rectangular coordinate system.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL MAP
NOBLE COUNTY - OKLAHOMA
SHEET NO. 3

OKLAHOMA AGRICULTURAL EXPERIMENT STATION

J. Kenneth Ableiter, Chief Soil Correlator.
C. P. Barnes, Chief Analyst, Soil Uses and Productivity.
James Thorpe, Principal Soil Correlator, Great Plains States.
Area inspected by E. G. Fitzpatrick, Soil Correlator, and
E. H. Templin, Senior Soil Correlator.
Soils surveyed 1938-40 by O. H. Brensing, in Charge, and
E. C. Talley, Oklahoma Agricultural Experiment Station.

Scale 1:24,000

1 ½ 0 1 2 Miles

5 000 0 5 000 10 000 Feet

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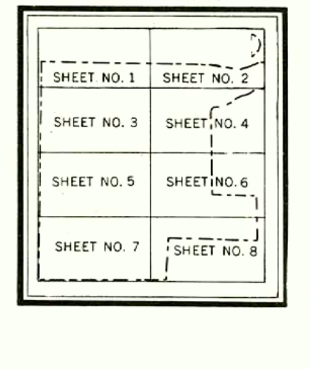
SHEET DIAGRAM



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Polyconic projection, 1927 North American datum.
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL MAP

NOBLE COUNTY - OKLAHOMA

SHEET NO. 4

OKLAHOMA AGRICULTURAL EXPERIMENT STATION

J. Kenneth Ableiter, Chief Soil Correlator.
C. P. Barnes, Chief Analyst, Soil Uses and Productivity.
James Thorpe, Principal Soil Correlator, Great Plains States.
Area inspected by E. G. Fitzpatrick, Soil Correlator, and
E. H. Templin, Senior Soil Correlator.
Soils surveyed 1938-40 by O. H. Brensing, in Charge, and
E. C. Talley, Oklahoma Agricultural Experiment Station.

Scale 1:24,000

1 ½ 0 1 2 Miles

5000 0 5000 10000 Feet

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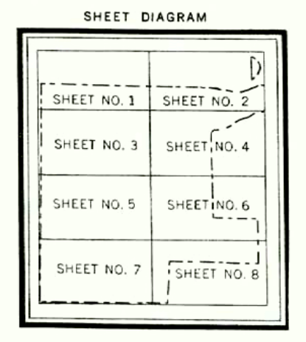
SHEET DIAGRAM



Alphabetical Legend, Color Grouping, and Conventional Signs are located on sheets 1, 2, and 8.

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Soils surveyed on 1937 aerial photographs.
Polyconic projection, 1927 North American datum.
10000-foot grid based on Oklahoma (North) rectangular coordinate system.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL MAP
NOBLE COUNTY - OKLAHOMA
SHEET NO. 5

OKLAHOMA AGRICULTURAL EXPERIMENT STATION

J. Kenneth Ableiter, Chief Soil Correlator.
C. P. Barnes, Chief Analyst, Soil Uses and Productivity.
James Thorp, Principal Soil Correlator, Great Plains States.
Area inspected by E. G. Fitzpatrick, Soil Correlator, and
E. H. Templin, Senior Soil Correlator.
Soils surveyed 1938-40 by O. H. Brensing, in Charge, and
E. C. Talley, Oklahoma Agricultural Experiment Station.

Scale 1:24,000

1 ½ 0 1 2 Miles

5000 0 5000 10000 Feet

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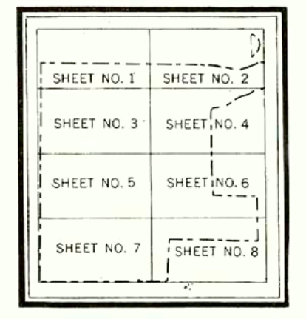
SHEET DIAGRAM



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Polyconic projection, 1927 North American datum.
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL MAP

NOBLE COUNTY - OKLAHOMA

SHEET NO. 6

OKLAHOMA AGRICULTURAL EXPERIMENT STATION

J. Kenneth Ableiter, Chief Soil Correlator.
C. P. Barnes, Chief Analyst, Soil Uses and Productivity.
James Thorp, Principal Soil Correlator, Great Plains States.
Area inspected by E. G. Fitzpatrick, Soil Correlator, and
E. H. Templin, Senior Soil Correlator.
Soils surveyed 1938-40 by O. H. Brensing, in Charge, and
E. C. Talley, Oklahoma Agricultural Experiment Station.

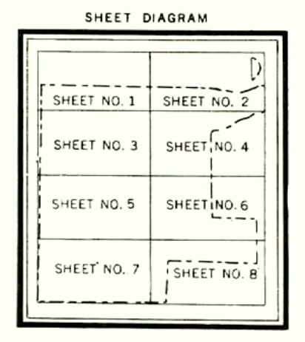
Scale 1:24,000

1 ½ 0 1 2 Miles

5 000 0 5 000 10 000 Feet

☆ U. S. GOVERNMENT PRINTING OFFICE : 1955 O—366000

SHEET DIAGRAM



Alphabetical Legend, Color Grouping, and Conventional Signs are located on sheets 1, 2, and 8.

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Soils surveyed on 1937 aerial photographs.
Polyconic projection, 1927 North American datum.
10 000-foot grid based on Oklahoma (North)
rectangular coordinate system.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL MAP
NOBLE COUNTY - OKLAHOMA
SHEET NO. 7

OKLAHOMA AGRICULTURAL EXPERIMENT STATION

J. Kenneth Ableiter, Chief Soil Correlator.
C. P. Barnes, Chief Analyst, Soil Uses and Productivity.
James Thorpe, Principal Soil Correlator, Great Plains States.
Area inspected by E. G. Fitzpatrick, Soil Correlator, and
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Soils surveyed 1938-40 by O. H. Brensing, in Charge, and
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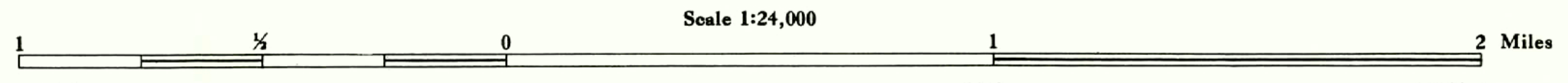
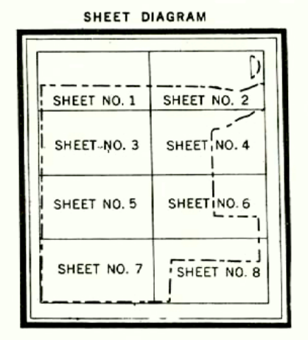
Scale 1:24,000



☆ U. S. GOVERNMENT PRINTING OFFICE: 1955 O—366000

SHEET DIAGRAM



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10000-foot grid based on Oklahoma (North)
rectangular coordinate system.

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL MAP
NOBLE COUNTY - OKLAHOMA
SHEET NO. 8

OKLAHOMA AGRICULTURAL EXPERIMENT STATION

LEGEND

Aa Albion loam, 2-5 percent slopes

Ab Albion loam, eroded, 5-8 percent slopes

Ba Broken land, Reinach soil material, 20+ percent slopes

Cb Calumet silty clay loam, 0-1 percent slopes

Ca Calumet-Drummond silt loams, 0-1 percent slopes

Cd Canadian fine sandy loam, 0-3 percent slopes

Cc Canadian fine sandy loam, 3-5 percent slopes

Cg Chickasha loam, 0-3 percent slopes

Ce Chickasha loam, 3-5 percent slopes

Cf Chickasha loam, eroded, 3-5 percent slopes

Ch Chickasha loam, 5-10 percent slopes

Ck Chickasha loam, eroded, 5-10 percent slopes

Da Dale silt loam, 0-1 percent slopes

Db Darnell-Stephenville fine sandy loams, 3-10 percent slopes

Dc Derby loamy fine sand, 3-7 percent slopes

Ga Gowen silt loam, 0-1 percent slopes

Gb Gowen silty clay loam, 0-1 percent slopes

Kb Kay silty clay loam, 0-1 percent slopes

Ke Kirkland silt loam, 0-2 percent slopes

Kc Kirkland silt loam, 2-4 percent slopes

Kd Kirkland silt loam, eroded, 2-4 percent slopes

Ka Lela clay, 0-1 percent slopes

La Lucien stony loam, 3-10 percent slopes

Lb Lucien very fine sandy loam, 3-5 percent slopes

Lc Lucien very fine sandy loam, 5-10 percent slopes

Ld Lucien very fine sandy loam, eroded, 5-8 percent slopes

Ma Miller clay, 0-1 percent slopes

Mb Miller silty clay loam, 0-1 percent slopes

Na Vanoss silt loam, 0-1 percent slopes

Nb Norge silt loam, 1-5 percent slopes

Nc Norge silt loam, eroded 1-5 percent slopes

Nd Norge silt loam, 5-8 percent slopes

Ne Norge silt loam, eroded, 5-8 percent slopes

Oa Oil-waste land

Ob Owens clay, 5-10 percent slopes

Ra Port silt loam, 0-1 percent slopes

Rb Port silty clay loam, 0-1 percent slopes

Re Renfrow silt loam, 1-2 percent slopes

Rc Renfrow silt loam, 2-4 percent slopes

Rd Renfrow silt loam, eroded, 2-4 percent slopes

Rf Renfrow silty clay loam, 2-4 percent slopes

Rg Renfrow silty clay loam, eroded, 2-4 percent slopes

Rh Rough broken land, Norge soil material, 10+ percent slopes

Rk Rough broken land, Vernon soil material, 10+ percent slopes

Rl Rough stony land, Darnell soil material, 10+ percent slopes

Sa Sogn stony clay loam, 5-30 percent slopes

Sb Summit silty clay loam, 1-3 percent slopes

Tb Tabler silt loam, 0-1 percent slopes

Ta Tabler silt loam, eroded, 1-3 percent slopes

Va Vernon clay loam, 4-10 percent slopes

Ya Yahola silt loam, 0-1 percent slopes

COLOR GROUPING

Cb Calumet silty clay loam, 0-1 percent slopes
Ke Kirkland silt loam, 0-2 percent slopes
Re Renfrow silt loam, 1-2 percent slopes
Tb Tabler silt loam, 0-1 percent slopes

Kc Kirkland silt loam, 2-4 percent slopes
Kd Kirkland silt loam, eroded, 2-4 percent slopes
Rc Renfrow silt loam, 2-4 percent slopes
Rd Renfrow silt loam, eroded, 2-4 percent slopes
Rf Renfrow silty clay loam, 2-4 percent slopes
Rg Renfrow silty clay loam, eroded, 2-4 percent slopes
Ta Tabler silt loam, eroded, 1-3 percent slopes

Sb Summit silty clay loam, 1-3 percent slopes

Nb Norge silt loam, 1-5 percent slopes
Na Vanoss silt loam, 0-1 percent slopes

Nc Norge silt loam, eroded, 1-5 percent slopes
Nd Norge silt loam, 5-8 percent slopes
Ne Norge silt loam, eroded, 5-8 percent slopes

Cg Chickasha loam, 0-3 percent slopes
Ce Chickasha loam 3-5 percent slopes

Cf Chickasha loam, eroded, 3-5 percent slopes
Ch Chickasha loam, 5-10 percent slopes
Ck Chickasha loam, eroded, 5-10 percent slopes

Cd Canadian fine sandy loam, 0-3 percent slopes
Cc Canadian fine sandy loam, 3-5 percent slopes

Dc Derby loamy fine sand, 3-7 percent slopes

Aa Albion loam, 2-5 percent slopes
Ab Albion loam, eroded, 5-8 percent slopes

Ba Broken land, Reinach soil material, 20+ percent slopes
La Lucien stony loam, 3-10 percent slopes
Lb Lucien very fine sandy loam, 3-5 percent slopes
Lc Lucien very fine sandy loam, 5-10 percent slopes
Ld Lucien very fine sandy loam, eroded, 5-8 percent slopes
Oa Oil-waste land
Ob Owens clay, 5-10 percent slopes
Rh Rough broken land, Norge soil material, 10+ percent slopes
Rk Rough broken land, Vernon soil material, 10+ percent slopes
Sa Sogn stony clay loam, 5-30 percent slopes
Va Vernon clay loam, 4-10 percent slopes

Db Darnell-Stephenville fine sandy loams, 3-10 percent slopes
Rl Rough stony land, Darnell soil material, 10+ percent slopes

Kb Kay silty clay loam, 0-1 percent slopes
Ma Miller clay, 0-1 percent slopes
Mb Miller silty clay loam, 0-1 percent slopes

Ca Calumet-Drummond silt loams, 0-1 percent slopes
Ka Lela clay, 0-1 percent slopes

Da Dale silt loam, 0-1 percent slopes
Ga Gowen silt loam, 0-1 percent slopes
Gb Gowen silty clay loam, 0-1 percent slopes
Ra Port silt loam, 0-1 percent slopes
Rb Port silty clay loam, 0-1 percent slopes
Ya Yahola silt loam, 0-1 percent slopes

CONVENTIONAL SIGNS

CULTURE
(Printed in black)

City or Village, Roads, Buildings, Wharves, Jetties, Breakwater, Levee, Lighthouse, Fort

Secondary roads, Trails

Railroads (DOUBLE TRACK, SINGLE TRACK, ABANDONED R. R., IN ROAD)

Bridges, Ferry

Railroad crossings (R. R. ABOVE, TUNNEL, R. R. BELOW)

Ford, Dam, Sawmill, Windmill

Boundary lines (STATE, COUNTY, CIVIL TOWNSHIP)

School, Church, Creamery, Cemeteries

Boundary lines (RESERVATION, LAND GRANT, CITY OR VILLAGE)

Gumbo, scabby, or slick spot *(truncated solodized Solonetz)* Oil or Gas wells

U. S. Township and Section lines, Recovered corners

Forest fire station, Airway beacon, Oil or Gas tanks

Transmission line, Oil or Gas pipe line

Mine or Quarry, Gravel pit, Rock outcrop, Made land

Soil boundaries; Stony, Gravelly, and Cherty areas

RELIEF
(Printed in brown or black)

Contours, Depression contours

Prominent hills or Mountain peaks

Sand, Wash, Sand dunes

Bluff, Escarpment, Mine dumps

DRAINAGE
(Printed in blue)

Streams, Springs, Wells, Flowing wells

Lakes, Ponds, Intermittent lakes

Unsurveyed and Intermittent streams

Water pipe lines, Canals, Ditches, Flumes

Swamp, Salt marsh

Submerged marsh, Tidal flats

ACCELERATED EROSION
Gully not crossable with farm equipment

J. Kenneth Ableiter, Chief Soil Correlator,
C. P. Barnes, Chief Analyst, Soil Uses and Productivity.
James Thorp, Principal Soil Correlator, Great Plains States.
Area inspected by E. G. Fitzpatrick, Soil Correlator, and
E. H. Templin, Senior Soil Correlator.
Soils surveyed 1938-40 by O. H. Brensing, in Charge, and
E. C. Talley, Oklahoma Agricultural Experiment Station.

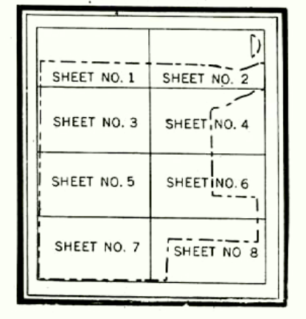
Scale 1:24,000

1 ½ 0 1 2 Miles

5000 0 5000 10000 Feet

☆ U. S. GOVERNMENT PRINTING OFFICE: 1955 O—366000

SHEET DIAGRAM



Alphabetical Legend, Color Grouping, and Conventional Signs are located on sheets 1, 2, and 8.

Map constructed by Division of Cartography,
Soil Conservation Service, USDA,
from 1937 aerial photographs.
Soils surveyed on 1937 aerial photographs.
Polyconic projection, 1927 North American datum.
10000-foot grid based on Oklahoma (North)
rectangular coordinate system